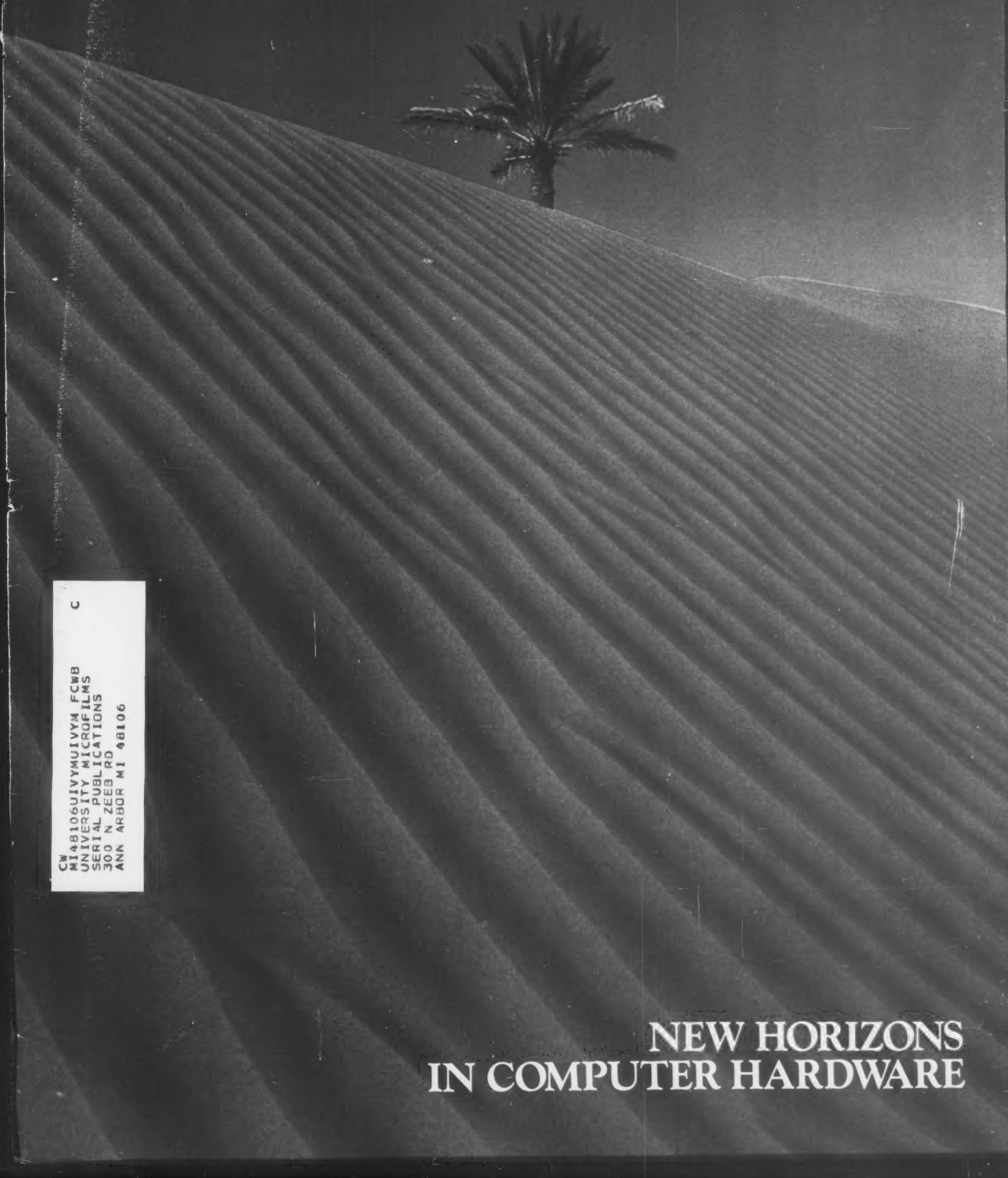
NOVEMBER 17, 1982 VOLUME XVI NUMBER 46a

COMPUTERWORLD

Extra!



NEW HORIZONS
IN COMPUTER HARDWARE

To see the world in a grain of sand
And a heaven in a wild flower,
Hold infinity in the palm of your hand
And eternity in an hour.
William Blake

These words seem to have more than passing significance for people who work with computers. Our world indeed is a grain of sand, and we are still exploring the limits of silicon technology. Our cover photograph suggests the hope and promise of computers — constantly evolving, meeting more and more users' needs, yet still the result of a simple grain of silica.

This is the first *Computerworld Extra!* devoted to what we commonly term hardware — the synthesis of ideas and devices that comprise computer systems. We hope you find the world we've created for you as fascinating as we do.

E X T R A

COMPUTERWORLD

Extra!

CW COMMUNICATIONS/INC.
Box 880, 375 Cochituate Road,
Framingham, Mass. 01701

Board Chairman/Publisher Patrick J. McGovern

President	W. Walter Boyd
Senior VP	Lee Vidmer
Group VP-Communication Services	Jack Edmonston
Group VP-Circulation	Margaret Phelan
VP-Marketing	Roy Einreinhofer
VP-Sales	Donald E. Fagan
VP-Finance	William P. Murphy
VP-Editorial	John C. Whitmarsh
VP-Special Publications	Robert Ziegel
Editor	Jack B. Rochester
Copy Editor	Nancy Fleming
Art Director	Tom Monahan
Design Director	Garrow Throop
Production Director	Peter Holm
Production Coordinator	Marlene Stibal
Typesetting Manager	Carol Polack

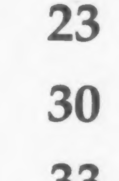
Second-class postage paid at Framingham, Mass., and additional mailing offices PN127420. *Computerworld* (ISSN-0010-4841) is published weekly, except: March (7 issues), June (5 issues), September (6 issues), November (6 issues), December (4 issues) and a single combined issue for the last week in December and the first week in January by CW Communications/Inc., Box 880, 375 Cochituate Road, Framingham, Mass. 01701.

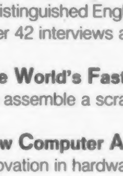
Computerworld subscription prices: $1.50 a copy; U.S. — $44 a year; Canada, Central & So. America — $110 a year; Europe — $165 a year; all other countries — $245 a year (air-mail service). *Computerworld Extra!* single copy price: $7.50. Four weeks notice is required for change of address. Please allow six weeks for new subscription service to begin.

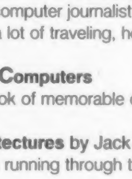
Computerworld can be purchased on 35mm microfilm through University Microfilm Int., Periodical Entry Dept., 300 Zebb Rd., Ann Arbor, Mich. 48106. Phone: (313) 761-4700. *Computerworld* is indexed: write to Circulation Dept. for subscription information.

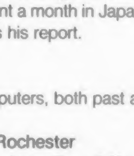
POSTMASTER: Send Form 3579 (Change of Address) to Computerworld Circulation Dept., Box 880, 375 Cochituate Road, Framingham, MA 01701.

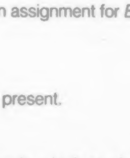
CONTENTS











A Message Center acts as everyone's personal secretary.

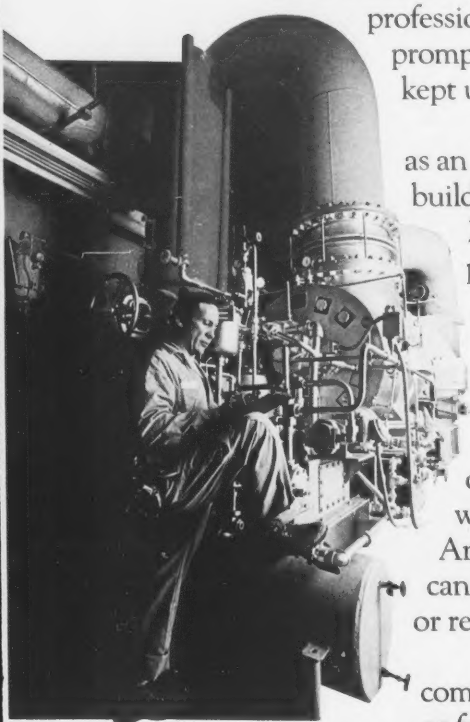
Bell's adding new dimensions to Dimension.

Bell keeps the benefits coming. You start with a highly flexible system for as few as 40 telephones, as many as 25,000. Step by step, as needs require, you add the specialized software functions Bell now makes available to those with new or existing Dimension® PBXs.

Add Data Switching and you integrate voice and data communications, transmitting data at rates up to 9.6 kilobits per second without costly adapters (modems).

Now one system for both voice and data.

Add the Message Center and calls get answered professionally, messages get delivered promptly, itineraries and directories are kept up to date, productivity rises.



Energy Management can monitor a variety of equipment for a variety of businesses.

Add Energy Management as an adjunct system that can cut your building's energy consumption up to 20% or more. Then, as improved productivity and cost effectiveness expand your business, add the Distributed Communications System to spread the benefits of advanced communications to multiple locations—while retaining centralized control.

With Dimension PBX you have today's best-selling communications system. You have a way to make functional advances without the expense and disruption of new installations.

And as Bell introduces its next generation of systems, you can carry over many of these benefits without changing operations or retraining your people.

Learn how Bell's new advancements can keep the benefits coming for your business. Call your Bell System Account Executive, or for further information, call toll-free 1 800 345-8800. Ask for Operator 20.

The knowledge business

In 1967, there were only about 10 computer manufacturers in the United States. Today, there are about 400.

How does a buyer find the right one?

ANNOUNCING THE COMPUTERWORLD BUYER'S GUIDE SERIES.

In 1983, *Computerworld* will be introducing a series of product-specific Buyer's Guides. Complete and concise, these guides will offer detailed, all-inclusive listings (we've sought out *every* company) and up-to-date information (right from the manufacturer), gathered by International Data Corporation (IDC), the world's leading information industry market research firm.

Each guide will cover a particular product area in the computer industry with extensive company and product information as well as editorial on product trends, new technology and handy referral charts. All presented in a manageable, easy-to-use format.

As a *Computerworld* subscriber, you'll find these guides invaluable tools in locating the right supplies for your needs.

As an advertiser, you'll find the guides a uniquely powerful vehicle for telling your story to executives at the moment they are actively seeking vendors. Make sure your ad is there (along with your free listing) to tell your story and complete your sales call.

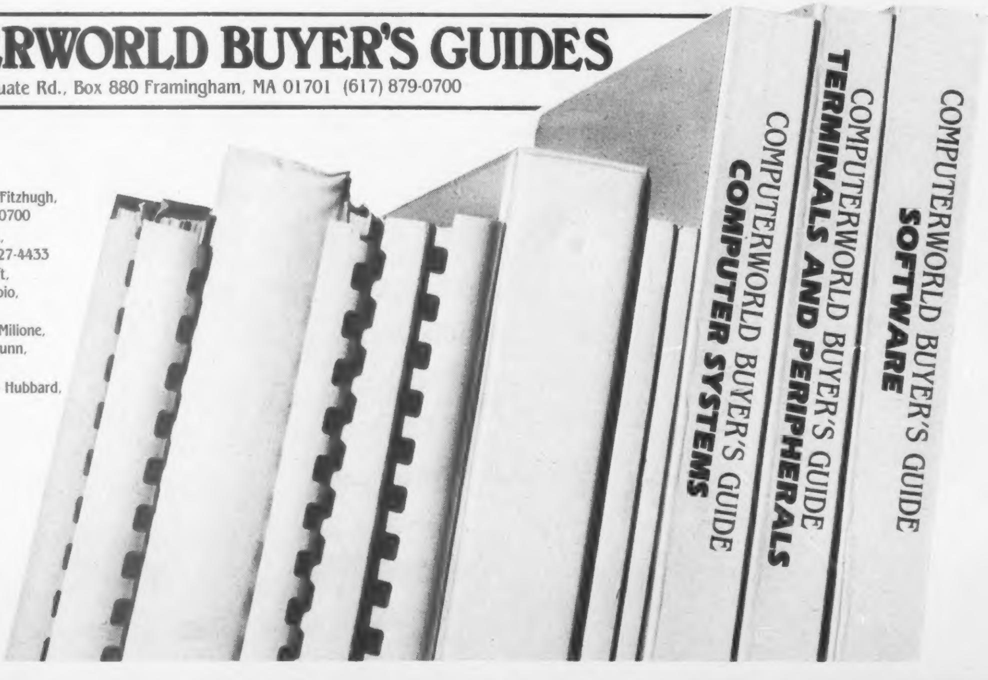
The ***Computer Systems Buyer's Guide,*** with everything from micros and desktops for business to mainframes, will be the first in our series for 1983. It will be sent exclusively to the more than 110,000 *Computerworld* subscribers in the United States, as will all the guides in the series.

Watch for the additional Buyer's Guides from *Computerworld* in 1983: *Terminals & Peripherals* and *Software.*

For more information on advertising in any of our new Buyer's Guides, call your local* Computerworld *sales representative.

COMPUTERWORLD BUYER'S GUIDES

375 Cochituate Rd., Box 880 Framingham, MA 01701 (617) 879-0700



Sales Offices:

BOSTON/ Chris Lee, Ed Marecki, Joe Fitzhugh, Kathy Doyle, Diane Sukey, (617) 879-0700

CHICAGO/ Art Kossack, Newt Barrett, Marguerite Winkler, Chris Lee (312) 827-4433

NEW YORK/ Mike Masters, Peter Senft, Doug Cheney, Ray Corbin, Fred LoSapio, (201) 967-1350

SAN FRANCISCO/ Bill Healey, Barry Milione, Rick Jamison, Ruth Gordon, Eileen Dunn, (415) 421-7330

LOS ANGELES/ Jim Richardson, Bob Hubbard, Beverly Raus, (714) 556-6480

ILLUSTRATION BY ERROLL ZACHERY

RETHINKING COMPUTER SYSTEMS ARCHITECTURE

After visiting Lilliput and Brobdingnag, Lemuel Gulliver took a third voyage to the floating island of Laputa. Here Jonathan Swift's famous sojourner found a brilliant but awkward race of people, preoccupied with abstract speculation and quite oblivious to their practical surroundings. Each inhabitant was led about by a servant, who, by tapping him on the mouth or ear, reminded his hapless master to speak or to listen. One eye turned inward and the other turned upward, the Laputian was forever lost in introspection and transcendence.

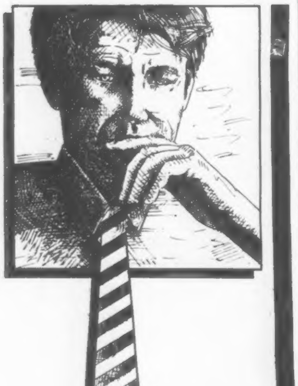
Today's information systems executive has one eye turned inward on the technicalities of administering substantial budgets for applications development and ongoing operations, just as traditional data processing begins to decline in relevance. Meanwhile, the other eye is turned upward to the lofty heights of information resource

By Cornelius H. Sullivan Jr.

Rethinking Computer Systems Architecture

management, endeavoring to transcend the shortcomings of conventional hardware and software administration, just as incredible volumes of new hardware and software cry out for attention.

In the face of such new developments as office automation, computer-aided design and manufacturing (CAD/CAM), distributed data processing, robotics and personal computing, Laputian narrow-mindedness seriously hampers the ability of business to take advantage of information technology. What follows is an introduction to a conceptual framework better suited to the emerging information age. The new perspective is called information systems architecture. Its objective is a synthesis of form. Through a planning process, architecture promotes the coordination of business and systems that will become crucial to successful enterprise in the years ahead.



What Is It?

"I'm convinced we have a major product opportunity here," the chief executive officer (CEO) of a large financial services institution exclaimed. "What we need to do is to package our new forecasting data with the old order-entry system, then integrate them with our specialized mailing lists, the data network, this proposed position-tracking simulator and the econometric model my aide has put together on this micro."

"Well, you'll have to speak to the Operations Research Department about their minicomputer," the information systems executive replied. "Remember, we decentralized last year. I'm not sure what our branches have done with workstations. Each profit center has customer files on its own word processors. The network is under the Administration Department. And I didn't even know you had a personal computer. Now, our systems development methodology calls for the completion of several prefeasibility questionnaires."

"Hold on, Bill," the CEO interrupted, "this is important. The game is changing. Computers are crucial to our business. Information is our product. Don't tell me you don't know what's feasible. Who's taking the overall view? Our approach to information systems reminds me of what we used to say as kids in the huddle before the big play — 'Everybody out for a pass.' "

Over the years, Bill and his staff had mastered the basic computer resource. Their experience can be seen, at least retrospectively, to have been a classic case of organizational learning. Charge-out schemes were put in place, along with production controls, capacity planning, application portfolio management, quality assurance programs and the like. More recently, the notion of data resource management appeared, shifting the focus of attention from computers to data as the key asset. It led eventually to a variety of new controls, such as data security, data administration and data dictionaries. Computer resource management and data resource management each made a permanent contribution to the evolving discipline of overall information technology administration. Valuable as the insights provided by each perspective were, however, they clearly did not solve the entire problem. Other things began to happen, attributable in large measure to the following underlying factors:

- The microprocessor revolution: the emergence of small, low-cost computer circuits and the appearance of these chips in an ever-increasing variety of specialized devices.
- User insurrection: reaction to overcontrol of information technology resources by DP professionals, coupled with increasing confidence on the part of users that they are qualified to take more responsibility for systems management.
- Arrival of the information age: increasing importance of systems and technology for business processes and products. Few industries do not now find themselves in the position of competing through information-based product differentiation.

These circumstances have conspired with the profit motive to produce a multiplicity of new computer uses throughout many companies. Digital devices are sprouting like dandelions in May: One major insurance company recently counted 1,200 "programmable data processors" at corporate headquarters alone. The count did not include the massive project under way to install small computers at all sales offices.

This is the irony of information technology in the 1980s. Digital computers are raining in on the organization just as the reins are slipping out of hand. The massive deployment of electronics throughout a company is often accompanied by an equally massive dismantling of the traditional planning apparatus, controls and management structure that guided and shaped the company's earlier exploitation of technology. Infusion and diffusion go hand in hand. Frequently, the result is technological clutter.

How can Bill — or any information systems executive — respond to this emerging information technology environment? What should be his role? It is certain that the central systems group is not going to disappear. Its impact is likely to increase in an effort to ensure that the effectiveness of the resource is not lost just as it finally becomes strategic. But the leadership role of the function is changing dramatically — from one of supplying, operating and controlling individual applications to one of forging overall cohesion of otherwise largely dispersed efforts.

The real alternative to Laputian oblivion under these circumstances is to eschew clutter in search of a new order. The transition is from the twin traps of introspection and transcendence to a practical but overarching perspective. The new information system executive needs a synthesis of form. This is information systems architecture.

A Definition

All architecture is an effort to achieve fit or harmony between form and context. Not the form alone, but the ensemble comprising form and context is the goal. In city planning, for example, the form might include a set of roads, buildings and parks to be constructed. The context is the set of people who are to live and work in the city, defined in terms of their values, needs, fears and other factors. The architect endeavors to design a city — the form — that meets the requirements of the people — the context. His success is measured by the degree of fit between the two — the quality of the ensemble. If the people are accustomed to lunchtime meetings and his design provides for no public downtown restaurants, then he has created a certain amount of misfit. Conversely, if people want to enjoy the stimulation of varied sights and sounds while walking to work, and the architect creates alternative commuting patterns with ample activities and diversions along the way, then he has taken this one step toward a successful ensemble.

Information systems architecture is no different. Here the form consists of the computers, communications facilities and data bases that constitute the information technology investment of an enterprise. The context is the business itself. The information systems architect tries to design a system of systems — the form — that meets the needs of the enterprise. His success is measured by the degree of fit achieved. For example, if the business requires substantial access to volatile information generated and stored outside the enterprise, but the architecture provides awkward or untimely access disciplines to that data, then the architecture is creating misfit. On the other hand, if the business needs interbranch communications to manage its open order and inventory positions, and the architect provides a flexible way for a variety of messages to travel among widely dispersed facilities, he is achieving a good fit.

The Business Case

The vast majority of business enterprises still have, at best, an informal architecture. Some do not even approve of the notion: Consciously designing, building and maintaining an infrastructure of any kind appears dreadfully abstract, even effete. It smacks of technological aesthetics and is therefore abhorrent, a violation of the old maxim that says technology must serve the business and not the other way around. So why is architecture on everyone's mind? What is the fundamental reason for it? Does it make economic sense? Before going into any details about building and using an information systems architecture, it is worth noting the most frequently cited business cases:

Efficiency: Architecture can actually save money. The standards and utilities group at one large bank now has a combined annual budget exceeding $600,000, including depreciation charges for hardware and software. The group allocates a flat charge of $25,000 per applications development project per year in an environment with an average of 25 active projects at any one time. Three of the medium-size projects have taken the trouble to identify cost-savings associated with the existence of the group. In each case, the architec-

ture survived investment analysis, even in the conventional senses of the term, such as payback and ROI. Hard-dollar savings accrues to that firm from such architectural elements as the standard data dictionary, the communications utility and the corporate workstation. In short, architecture pays.

Documentation: The promise of architecture goes well beyond efficiency. For one thing, it can be a new kind of maintenance tool. A major Wall Street firm found that architecture lets it see immediately and precisely the effect on its systems if a change in business should occur, such as a reorganization of the company, the appearance of a new financial instrument or regulatory change. Or, conversely, it can let the company see immediately and precisely what the effect on the business would be if a change in systems occured, for example, because of a system failure, an upgrade or a migration. Here architecture documents the overall portfolio of technologies and relates them to business functions.

Control: Architecture can also provide a broader set of management controls for a highly distributed processing and data storage environment, such as the one that evolved at a large petrochemical company. This firm recognized that the desire of line managers to control their own systems development and operations far outstrips the management control capabilities and safeguards built into standard operating systems and data base management systems (DBMS). The central systems group had to develop its own overall control systems. Here architecture became the countervailing force, the prudent antithesis to distributed computing. Every distributed application in all departments and divisions is now required to adhere to a set of 23 basic standards. Moreover, barring extenuating circumstances, they are also required to use the corporate communications utility and data archives. Architecture reintroduces accountability.

Effectiveness: Some firms, particularly those in the burgeoning information industry, find themselves in the position where their infrastructure is their product. This is true in the case of a time-sharing vendor, a common carrier or any kind of data base service. Here architecture becomes strategic and applications are tactical. The whole ability of a firm to compete begins to depend on the quality of the design it creates and how well the form fits its marketplace context. At this point, the distinction between infrastructure and the business dissolves: Architecture is the enterprise.

Framework for Analysis

One definition of a modern civilization is that it possesses a profession of architects. The primitive culture, by contrast, is simple, anonymous and is not self-conscious. In one case, the number of variables associated with design problems is small and the weight of tradition is large. In the other, design problems are complex and tradition dissolves. The designer's role changes from agent to achiever, from being an heir of the past and making minor adjustments only as needed, to one of trying to break loose and display originality. Adaptation for its own sake becomes the objective. Self-adjustment and resistance to willful change give way to the taste for individual expression. Form building becomes less the product of replication than of deliberate effort.

This is a suggestive way of viewing the transition that appears to be in progress in information systems. The culture has been primitive in the past in the same senses of simplicity, anonymity and lack of self-consciousness. Traditionally, the scope of information systems has been narrow; now technology is becoming pervasive. There was no self-described architect in the past; the source of overall design came from anonymous sources — the mainframe vendor, the DP manager's memory of the way things were in the last shop he worked or the simple weight of tradition.

Now we have alternative data base standards, communications protocols and idiosyncratic deployment of processing power throughout an organization in a variety of sizes, packages and brand names. As computing becomes more integral to a firm's operations, it takes on the special shape and texture of that company. Consequently, today's information systems executive must make a deliberate effort if he is to design an overall form that meets the unique business context. He is becoming an architect.

In a traditional culture, a form always tends to fit its context because of a constant, automatic and incremental process of self-adjustment. In a modern culture, it is up to the designer to make the process of adjustment happen. Absence of architecture today is obvious enough when it occurs. The key issue now is to create forms deliberately and in the face of an expanding number of variables, but still resulting in that same delicate match, or fit, into context that used to come automatically. The ensemble — form and context together — is increasingly unique. No single design suits all companies anymore. Instead, the design solution is intimately interleaved with the context of the problem. Each firm must now discover its own information systems architecture.

Design of clearly conceived forms well adapted to a given context requires the discovery of the underlying structural correspondence between the pattern of an environment and the form most suited to it. For this to be feasible in information systems, both the systems form and the business context must be broken down into interacting subsystems. Decomposition of the business context creates lists of business activities and the breakdown may take place in one or more of at least three ways:

1. *Geography* — branch location, plant site, country or other physical entity.

2. *Function* — traditional business organization, such as marketing, production, finance.

3. *Business unit* — product line, markets or customers.

Alongside the business context is the systems form. Decomposition here should follow the pattern established by the specialized parts of the information technology base. We should view the company's investment in technology as a system of systems, consisting of three basic parts:

1. *Processes* — Sets of algorithms or programs to manipulate or add value to information.

2. *Stores* — Repositories of information over time, along with associated storage management apparatus.

3. *Flows* — Movements of information between processes and/or stores.

Each decomposition produces a set of components on one side of the ensemble. On the demand side, or business context, each component has discrete requirements for integration. Integration is the key measure of success of an architecture. It is the objective function, the dependent variable. If integration is unnecessary, no architecture is needed. Moreover, the potential contribution of architecture to the enterprise is directly related to the overall importance of integration, which clearly varies greatly from one company to another. In addition, the importance of integration will vary over time and from one part of the organization to another. Finally, different kinds of integration are quite likely to vary in importance. The kind of architecture needed is determined by the nature of integration required.

At least six basic varieties of integration are discernible today and should be accounted for:

- **Horizontal** — Across business functions, such as accounting, marketing and manufacturing.
- **Vertical** — Across levels of control, such as from operational levels to management control and planning.
- **Temporal** — Through time series, such as from one period or year to another.
- **Longitudinal** — From one business unit or product line to another.
- **Physical** — Among physical locations, such as branches, factories or distribution centers.
- **Gateway** — Between the enterprise and the outside world, such as other companies, customers, suppliers, the government.

On the supply side of the ensemble, or systems form, each component makes some discrete contribution to integrate, or fit, on two levels, the logical and the physical.

The logical elements of an architecture are standards. These include the guidelines, suggestions, "standard operating environment" descriptions or other lists of constants to which the parts of the architecture are supposed to adhere. This is the rule book. Examples include vendor standards for different kinds of computing, communications protocols, screen formats and data definitions.

The physical elements of an architecture are utilities. These are the common systems, such as a multiprogrammed computer, a multiplexed network or a DBMS. The essence of a utility is that it is shared.

In summary, the framework consists, on one side of the form/context boundary, of a set of business activi-

Computers are raining in on the organization just as the reins are slipping out of hand.

ties profiled in terms of their integration needs. On the other side of the ensemble is a set of systems elements profiled in terms of the standards and utilities they employ. After this framework has been established, a picture begins to take shape, consisting of four kinds of information: varieties of integration, business activities, system components and elements of architecture. Associations between the four parts of the ensemble are complex. A given business activity, for example, such as "accounting," may include several system components in its domain. Likewise, a system component, such as "trades data base," may encompass numerous business activities. The relationships between system components and elements of architecture also require many-to-many mapping. So does the association between business components and integration elements.

Figure 1 on Page 10 shows the information types and their interactions, as if they were logical record types in a data base. At the next level of greater detail, the data base becomes considerably more complex. Business activities, for example, may actually consist of three or more interrelated lists. Systems components always consist of interrelated processes, stores and flows. Needless to say, a good DBMS becomes indispensable, not only in the generation and maintenance of architecture documentation, but also in its use.

Using the Framework

The danger in the architectural perspective is that it will inspire us only to admire the problem. Although it is true that the simultaneous impact of massive information technology infusion and diffusion may be profound and dumbfounding, tragic awareness counts for little at performance review time. Those responsible for the information systems architecture at major companies need a framework, such as that described, to make the problem solvable, rather than admirable.

A tentative notion about the proper thrust of the architecture begins to become clear. Eventually, the information systems architecture strategy of a firm emerges as a formal commitment to achieve the level and type of systems integration the firm needs through an appropriate penetration and mix of standards and utilities. This strategy is the result of considering three key variables:

- Strategic impact: What is the relative importance of architecture and applications? At some firms, the applications are more important than the architecture; at others, they are of approximately equal importance. The advent of integrated cash management services for both commercial and personal accounts makes architecture actually of higher strategic importance than applications at financial services institutions today. Clearly, standards and utilities should play a large part in this kind of environment.
- Architectural role: Some architectures merely support applications, others serve mainly to increase reliability and still others transport or present products to customers. Occasionally, the architecture is the product. Each of these four roles — support, reliability, delivery and strategic — have definite implications for the most appropriate kind of architecture.
- Architecture focus: Focus is the essence of clarity. Every architecture needs a design focus, which tends to result in a concentration on one of the three system components. An information systems architecture may be focused on processing, as with a mainframe or workstation that serves as the organizing principle. Or, it may use a data storage facility as the primary form. Some now use a communications utility as the provider of clarity.

This raises a point about progress in information systems architecture. Is there a natural progression, a series of stages of growth in architecture? Certainly there are some appearances of one. Clear historical transitions in attention have taken place.

Early architectures were oriented toward processing — typically around a mainframe CPU that was multiprogrammed and time-shared to serve as the basic means of integration. More recently, data-oriented architectures have appeared, where DBMS and data dictionaries have served as the primary means of integration. At some firms, the arrival of extensive and versatile data networks are creating a third focus of integration. Networking resources management is the inevitable result. Most recently, there is talk, if not progress, suggesting a move back to a processing-oriented utility, but this time the focus is on the multipurpose workstation, rather than the mainframe.

At some firms, all four architectures have appeared sequentially, following technological advancement and new ideas. This approach has the advantage of maintaining clarity of form over time. Moreover, insofar as organizational learning must take place in an orderly fashion, this pattern makes some sense. Sequentially mastering computer, data and networking resource management is one way for a company to master the overall information technology environment. But there is little to suggest in these cases that such a pattern of change in focus was called forth by changes in the business context. Rather, it appears the technological form drove the business side of the ensemble, rather than blending with it.

Other firms have stuck resolutely to just one of these technological alternatives with remarkable tenacity over time. Concentrating narrowly on a single perspective is likely to lead to highly inappropriate management responses to diverse situations. The clearest example of this is the attempt to build computer rooms to house word processing equipment. At some firms, the false analogy went to fairly ludicrous extremes of literalness, including cinderblock walls, I/O windows, job control language, 24-hour turnaround whether you need it or not and everything else that bothered people about computer rooms. The very technology users looked to in an effort to escape onerous "stage three" controls was implemented by re-creating those controls with an exasperatingly faithful attention to detail.

Another approach is to focus simultaneous but independent and disjointed efforts on each of the basic perspectives. One major bank unconsciously chose to do this when it created three separate (and, as it turned out, noncommunicating) groups, charging each with the task of building THE bank utility. One group set out to construct a large general-purpose multiprocessor time-sharing system, in effect, allowing processing to be centrally coordinated thereon. The second undertook to build a back-end processor to hold the bank's data resource. The third planned a data highway to interconnect dispersed computers. Each idea looked meritorious when viewed in isolation. Each solved an identified problem of integration and predicted a solid return on investment. Viewed together, however, the efforts overlapped and contradicted each other hopelessly.

The last option is finding a way to view all three perspectives in a holistic manner, endeavoring to solve them, as it were, as simultaneous equations. From this point of view, processing, data stores and data flows are all considered from a unified perspective, as rationally decomposed elements of a single problem. The issue is not one of progressing through stages so much as one of optimally configuring the overall computer system that really is the enterprise. Changes in the architecture should be dictated by business changes — deregulation, competitive thrusts, new markets and products. Here is the new design challenge — the call to find a new order, a synthesis of form, in response to function. This is how information systems architecture may be put to best use. Some guidelines for action follow.

Tragic awareness counts for little at performance review time.

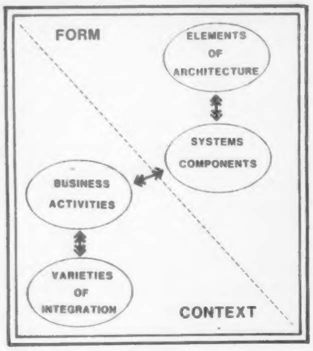


Figure 1

At many companies, investment in information technology is simultaneously growing in size, decentralizing in operation and becoming more strategic in importance. Accordingly, the set of interconnections of system components and the business requirements for those interconnections are multiplying. This complexity is not necessarily bad or to be avoided. Indeed, if the complexity can be organized and managed, if a synthesis of form can be achieved, it will be the most cost-effective period of rapid growth in information systems to date. Architecture can provide the needed framework. But practical results will not appear automatically. Here are some key guidelines for capitalizing on this perspective.

Introduce information systems architecture gradually: Architecture is a fundamental shift in emphasis — from managing pieces of the information resource to managing the whole. As a central force in a company, information systems architecture should rise in visibility and importance as applications development and operations decentralize. Architecture is a compensating balance, an adjustment for the vacuum in leadership created by the diffusion of technology. Obviously, this transition does not occur all at once. Modulate the pace of change.

A sequence that has proved most useful is to initiate architecture planning with an initial heavy emphasis on assessment. This produces the tangible results of documenting systems and integration needs. The assessment project serves to unfreeze an organization and make it more receptive to a strategic shift in the future. Subsequent efforts can begin to dwell more on the problems of improving clarity of design and fit into context. Ultimately, the objective is to generate specific standards and utility specifications.

Use architecture to imply structure: This is true not only for the information systems themselves, but also for the human resources needed to support the new information systems environment. The existing organizational structure of a systems department probably will not survive the rise of the architectural perspective. It is frequently a creature of the computer resource management era. Most firms have systems departments with marketing or functional orientations. Architecture introduces the primacy of standards and utilities as the two basic levels of centralized activity, along with processes, stores and flows as the three basic varieties of systems components. These are likely to become reflected in the organization.

Link architecture and applications planning: Information systems architecture is no panacea, nor does it replace applications planning. On the contrary, it can significantly enhance traditional applications-oriented planning processes. Interaction between the two should occur at several points. The applications portfolio helps to define the business environment from which integration requirements are profiled. In addition, the architecture will both constrain new information systems proposals and, in turn, be modified by the infrastructure needs of those proposals. Architecture planning will also generate its own proposals — for utility systems.

Too often, the management committee or other authority that reviews proposals for systems has few metrics (beyond some self-appointed authority's say-so) in its effort to compare and prioritize systems ideas. Investment analyses are generally available, but the fact that the ROI is always 35% tends to make this factor negligible over time. An architecture can embellish project reviews by giving the management committee a context for decisions. Very simply, a company with an explicit architecture can now see whether individual development efforts are taking the enterprise down the road it wants to go or onto a byway of unpredictable incompatibility. In this way, architecture replaces Laputian introspection and transcendence with insight. ◆

Sullivan is president of Information Technology Planning Corp. of Chicago.

The Psycho-Computer Syndrome

Case History No. 1

"Everything was 'Go.' For the last eight months, we had been working hard for this day. From vice-president to manager and down to the last clerk, we thought we would leap effortlessly into the information era. We were ready, and so was our much-planned computer system. Like explorers expanding new frontiers, we were eager to take the first step into the future and cull the obvious benefits awaiting us.

"The vice-president and his managers expected increased productivity and higher efficiency. Each had visions of greater bottom lines spurred by the innovations he had initiated. The clerical staff would merely hit the computer key and their jobs would be done — traditional office workers one day, information processors the next. The computer seemed their quick fix for everyday drudgery. Everyone anticipated success.

"However, during the system's first six months of life, productivity declined. Efficiency became a hostile word. Clerical morale shrank to an all-time low, and they began to ridicule the computer system and balk at using it. The vice-president and his

By Harold and Elizabeth Guarnieri

ILLUSTRATION BY CARL TUREK PHOTOGRAPHY BY GARROW THROOP

managers thought they had planned well and were baffled by what seemed to be a radical turn of events. What went wrong?"

The company described in the above case was experiencing the Psycho-Computer Syndrome. Prof. Sanford Weinberg of St. Joseph's University in Philadelphia has estimated that today as many as 30% of our population are cyberphobiacs — people who fear computers. The epitome of a cyberphobiac, he said, was a policeman who shot his squad car computer console.

Weinberg predicts the number of cyberphobiacs will increase as we continue to computerize. If this is so, and we have every reason to believe it is, you will eventually have to address this new phenomenon.

In the face of precipitous change, many capable and intelligent workers are resisting easy-to-use systems. The resisters range from clerks who must trade typewriters for word processors and ledger cards for computerized accounting systems, to executive vice-presidents who need extensive up-to-the-minute information. As a result, information managers are faced with frustrations, problems and challenges different from generally accepted management principles. They need to develop a new managerial strategy. They can do this by recognizing the phenomenon of the Psycho-Computer Syndrome.

Charles P. Lecht, an industry futurist, said, "What the lever was to the body, the computer system is to the mind." When the lever was introduced to a world using only the force of human strength, many probably doubted it could really benefit its users. They may have been concerned that continual use would lead to the body's atrophy.

Calculators met similar resistance 10 years ago, and today, many well-intentioned people are resisting computers, the mind-levers of the information era. Some believe that using them will cause the mind to atrophy. Others doubt computers can be consistently correct and efficient. Since they see their obvious benefits, these people are almost forced to praise the efficiency of computers on a logical basis. But most fear them on an emotional basis.

Case Study 2: The Barfing Clerk

At one company, after months of careful design and programming, management brought a computer terminal, completely unannounced, into the purchasing department one day. In the past, personnel had entered all purchasing information into a manual card file maintained on a large, ferris-wheel-like tub arrangement. The innovation was simple: They would now use the computer to enter, maintain and recall the information.

Management selected Jane, whom they felt was the most competent clerk in the department, to evaluate the system's effectiveness. Jane had not been asked if she wanted this task, nor had she prepared in advance for it. In fact, Jane had heard that computers eliminated jobs, and since she had been told to use the terminal, she assumed she would be the first casualty. She became so upset she vomited all over the terminal!

Introducing a computer in any office represents change, and each staff member reacts according to what they perceive they are gaining or losing in the deal. Management should try to analyze how people will respond to automation and how easy it will be for them to learn new skills and behaviors. If the staff is informed ahead of time, advised about the nature of the change and told what will be expected of them, they can make the necessary adjustments much more effectively. This is what the Psycho-Computer Syndrome is all about.

The Psycho-Computer Syndrome is a recognizable motivational pattern with eight stages that always emerge during the training of a first-time user. As you become familiar with the pattern, you will be able to pinpoint its consistent unravelling.

Perhaps you will eventually feel as we do: We are at an evolutionary threshhold. You are managing your staff's first steps into spheres of knowledge formerly reserved for scientists. You are in a way humanizing science. By the same token, science is enriching you and your staff. Your job is to manage both.

Eight Stages

As your staff learns how to use a system for the first time, they evolve from traditional office workers to members of a computerized office. Before they can emotionally and intellectually accept the computer as a useful, satisfying tool, they must pass through an eight-stage process:

1. General feelings of emotional and intellectual insecurity.
2. Ego-status disintegration.
3. Hostility/challenge.
4. Search for equilibrium: first sign that training can begin.
5. Formation of support group.
6. Significant learning success: first breakthrough.
7. Ego-status integration.
8. Equilibrium: a new office routine.

Stages 1 through 4 can be considered personal reactions, and 5 through 8 social reactions. Each stage is a continuum, having an element of the stage above and below it. In general, your staff's negative responses, if not recognized as a necessary stage of the Psycho-Computer Syndrome, can either fixate or regress to a lower stage of the Psycho-Computer Syndrome. Their positive responses, if not recognized as a necessary stage of the Psycho-Computer Syndrome, can become isolated occurrences. You can take advantage of both.

Although your staff is learning the same system, they may enter the Psycho-Computer Syndrome at different stages and progress through it at different rates. The stage at which each enters the syndrome depends on the individual's motivational needs. How quickly he passes through each stage is a combination of his personality structure and the sensitivity, thoroughness and quality of training he receives. It also depends upon the reliability and complexity of the system he is learning to use.

If the system needs to be shaken down — to have its errors or "bugs" detected and removed — your staff will be frustrated by continuous system errors. They will not have the opportunity to understand the system because the total system does not really exist.

If your staff is learning how to use a small, simple system, they may progress through the eight stages of the Psycho-Computer Syndrome in one day. If they are learning a larger, more complicated system, they may need a week, a month or longer.

If you recognize the Psycho-Computer Syndrome, you can enhance the effectiveness of every training session. If you understand the pattern of successive stages, you can build the strength of one stage into the strength of the next; you can mold the weakness of one stage into the strength of the next stage. Since the Psycho-Computer Syndrome is a pattern of responses, a worker's response does not remain just his response. It becomes part of a recognizable pattern. If you understand its subtleties, you can guide your staff to accept and appreciate the system you know will generate departmental and companywide benefits.

Stage 1: General feelings of emotional and intellectual insecurity. In most offices, each worker performs tasks according to a well-defined procedure. This kind of routine breeds a sense of security. As a result, what is boring becomes mindless; what is challenging gives a sense of status to the worker who accepts the challenge.

The introduction of a computer system temporarily eliminates much of this sense of security because each worker's task definition is changed. Each worker is required to learn not only a new skill and behavior, but also a new way of conceptualizing what he had been doing routinely in the past. In addition, he must enforce an unfamiliar discipline so that the new procedures are strictly followed. In essence, he is asked to evolve almost instantaneously — from a programmed worker to a worker who must program his task; from simple doer to thinker, planner and doer.

The degree of change demanded cannot fail to elicit a sense of anxiety. No matter how intelligent the worker, there exists a gnawing fear that he may not be able to learn the new skills as quickly as he should. The enormity of the perceived task at hand usually generalizes into feelings of emotional and intellectual insecurity.

Case Study 3: Unrest at the Club

In a small office, each of three workers had loosely defined tasks. Generally, one person maintained a certain set of books, another kept a different set of records and the third, a substitute for the other two, had general responsibilities in both areas. Their office had a country club atmosphere. Because no one perceived the other as a threat, each felt at ease to perform her job at her own pace.

A computer system made a radical change in their placid environment. One worker, unable to cope with her ignorance, rebelled. She complained

that the system didn't do a number of things and that it was generally unusable. In short, her job security slid into finding the computer's faults — some perceived, some real and some figments of her imagination. She began to dissociate herself from the other two clerks and to find fault with them. They, in turn, isolated her more and more.

Stage 2: Ego-status disintegration. Stage 1, general feelings of emotional and intellectual insecurity, directly affects each staff member's personal and social self. Stage 2, Ego-status disintegration, is so closely intertwined with Stage 1 that you may find it difficult to isolate the distinct occurrences of the two.

At Stage 2, each worker invariably feels he cannot learn the necessary cognitive skills and discipline. More often than not, he considers them incomprehensible and, as a result, generally experiences large emotional swings. If he perceives possible success, he becomes elated; when he encounters a setback, he becomes discouraged.

Your job is to focus on the factual basis of your staff's frustrations. Reality-testing is the key to your staff's advance to Stage 3. If the worker perceives he cannot successfully learn what is necessary, he will usually stagnate at Stage 2 and, if he enters Stage 3, he will typically enter it on the hostility side.

If the worker is not sure he can learn the required skills, he will need your continued support. You should view the negative response as just a necessary part of the Psycho-Computer Syndrome. You can then step back from your own emotional involvement and be alert to his signal that he can advance to the challenge side of Stage 3.

When the worker thinks he can succeed, there is almost no stopping the progress.

Case Study 4: Identity Crisis

When Grace, the cost accounting clerk with the greatest seniority, heard about the new computer, she experienced a very direct loss of status. Many tasks she had learned over the years were now performed by the system. She no longer had to tell the other clerks how to record nonroutine entries. The computer seemed to have all the answers.

Many of the other clerks discovered a new identity and experienced an exhilarating feeling of independence. In their enthusiasm, however, they made many mistakes. Grace did not; she was quick to emphasize this fact to her managers. She pointed out that all control seemed lost. Garbage was being entered into the system and garbage was coming out — the system was out of control. In her opinion, there was only one recourse: scratch the system.

Over the years Grace had earned her manager's trust and respect. They listened to her concerns. They were careful, however, to base their conclusions on facts. Recognizing the Gigo principle at work, they felt they had no recourse but to delay the system's implementation. The other clerks realized their efforts had produced mixed results and did not quibble over the decision. Grace had, in a sense, regained her lost ego-status.

Stage 3: Hostility/challenge. As soon as the worker internalizes that others similar to himself have accomplished what he is trying to do, he usually begins to feel more confident about trying it himself. He is ready to begin Stage 3, Hostility/challenge.

While the worker progresses through Stage 2, he generally is laying some necessary emotional groundwork. As he approaches the challenge side of Stage 3, he is signaling you that he can begin. He is telling you, "I'm ready to give it a try. I think I'm okay now."

If he has not successfully completed Stage 2, more often than not he will exhibit overt antagonism to the notion of ever being able to use a computer. If this happens, he is letting you know he feels unsafe. No doubt you have heard of beverages dumped into the electronics; magnets run across storage media; and metal filings, cigarette butts and water inside computer enclosures. We have also seen wires cut. Needless to say, the less time your staff spends in Stage 3 the better.

View any challenge to the system as a positive indication of the challenger's commitment to his company. It often represents his mind's first extension into what the system should do for him. (Or, sometimes it simply represents his resistance to the change required.) The basis for his challenge is frequently a concern that the system does not take care of his company the way he feels it should. Be careful to outline those policies affected and changed by the new system. Let each member of your staff know how the changes introduced by the system will benefit him, his department and his company.

Actively involve each worker. Introduce a healthy questioning of the system. Encourage every member of your staff to ask questions about what the system should do for him and his company. More often than not, a what's-in-it-for-me approach elicits a let's-get-started response. This kind of controlled conflict is often the spark that will help your staff members grow into the cognitive skills they need to develop.

Give your staff illustrations about functions they must learn — a picture is worth a thousand words. An illustration may be your shorthand to help them develop a more accurate mental picture of what they must learn.

Whenever feasible, adopt the "homily" approach. A story can help the worker experience a general and active expectation for success. There is no greater motivator than a good story that taps motivations and expectations.

Stage 4: Search for equilibrium — first sign that training can begin. Equilibrium is a psychological state in which the worker feels no forces can influence him to take a course of action other than the one he is currently following. The method selected by each worker is based upon the needs he believes he must satisfy — for example, job security, group acceptance or ego-status.

If the worker feels he must protect his job, he will commonly manipulate his environment until he can respond properly to the demands made upon him. If you do not adequately support him, he can easily regress to a lower stage. With skillful support he can advance quickly to Stage 5, formation of support group.

At Stage 4, each member of your staff has a critical potential for success or failure. Try to keep them on a successful trend, which almost invariably maintains their enthusiasm for the next challenge. Acknowledge every success your staff achieves and relate it to one of their previously voiced misgivings. By doing this, you are discarding your staff's objections one by one until they have none left. You are really saying, "I know you can do it!"

To eliminate fears about "botching it up," give your staff a practice system to play with before their real system is put on-line. The multiple successes they usually achieve will allow them to accept other challenges and will expand their confidence. As a result, your staff will generally learn at a faster pace. By the time they are ready to handle live data on their systems, they frequently have already learned how to use it. Because their frustrations have been kept to a minimum, their chances for continued success are significantly enhanced.

While the worker advances through stages 1 to 4, he is reacting mainly on an individual basis. In a sense, stages 1 to 4 represent his personal reactions. At Stage 5 the worker begins to seek a group that supports his point of view. In a sense, Stage 5 represents the worker's social reactions. As previously mentioned, a critical potential exists at Stage 4 for the worker to swing either for or against the system. Whichever direction he swings, he usually feels a need to solicit other workers to his point of view. You will generally sense a shift of alliances within your staff at Stage 5.

The computer will create a political arena, and your staff invariably will split into two groups: one for, the other against. Each group usually begins to campaign for those occupying the middle of the road.

When you were dealing with stages 1 through 4, you were trying to provide support and personal growth opportunities for your staff. Now you must deal not only with each staff member, but also with your staff as a group — a significant challenge. You will probably discover you need to adjust your strategy.

If your staff has reacted favorably to the change introduced by your system, your problems may be solved. A happy ending seems to be on the horizon.

If they have not reacted favorably, try to put your finger on the reasons. A good source for this information is the middle-of-the-road worker who does not belong to either group. Often, he is tugged by both sides to join them. Usually privy to each group's information, he can help you deciper each group's "hot buttons." A word of caution: Be careful not to single out any one worker as your buddy or you will both risk being ostracized.

Any challenge should be viewed as an employee's commitment to the company.

Unravel unseen causes behind your staff's negative responses. List what you intuit are each group's negative and positive concerns, then compare the two and analyze their differences. During this process, you will invariably discover their hot buttons. If you can address these, you will have used one of your most effective strategies at Stage 5.

At this stage, you can draw on the strengths of the system itself, a source outside the worker. Plan for the successes you know your system will give him. His successes will validate his expectations. With each new success, the worker's mental picture of what he is doing becomes clearer. He generally begins to understand some principles behind the "whys."

In some cases, the actual basis for his success may be trivial; in others, more sophisticated than you anticipated. Your guiding principle should be "Success breeds success."

When the worker experiences what he considers his first real success, he invariably begins to feel less dependent upon others for support. This is not to say he no longer needs them — only that he now feels he can trust his own abilities to learn those cognitive skills mentioned earlier. He senses he can be successful and starts to actively pursue his own success. His earlier concerns — job security, status within the group, ability to learn required cognitive skills — gradually recede in importance. Discarding his emotional baggage, he frequently relaxes, cooperates and learns at a faster pace.

Case Study 5: The Hot Potato

The managers of the distribution and cost accounting departments wanted to know why there was a difference between the figures produced by their systems. They ordered a physical inventory and also asked the auditing department to make a reconciliation. They discovered:

- Each system had a different time frame for the same data.
- Each system made a different interpretation of the same data when it was entered into the system.
- Some minor data input problems existed in both systems.
- Some undiscovered stealing was occurring.

Terry, a clerk in the distribution department, believed the data discrepancies could be reconciled. She began to study reports generated by both systems. Her manager, who, in this case, was also the developer of the system, listened to her logic and quietly guided her research. Although he had already developed an inventory turnover report to handle the problem, he allowed Terry to draw the same conclusions.

She seemed exhilarated by her research. Even though other clerks and one manager accused her of not understanding the accounting system, Terry seemed undaunted. She carefully compared the reports of each system and made a startling discovery: if inventory was not at the location indicated, it had been stolen within the week. She quickly informed her managers about this. They decided to spot-check their inventory. By performing a spot check, they actually caught the thief. Terry had achieved an unanticipated success.

The two departments now worked closely together to devise an early warning system based upon their respective computers. They used the two systems to alert them to the loss of physical control within the distribution facilities. When this occurred, they simply ordered a physical inventory of all trouble spots to regain control.

Neither department emerged from the fracas unblemished, but neither had lost face. The system had been implemented. Through Terry's efforts, the system had performed better than anyone had expected.

Stage 7: Ego-status integration: At this stage, the worker is likely to think the cognitive skills and discipline demanded by his new office tool are not only possible but also achievable. He bases his expectations on facts; he has achieved concrete successes. In addition, he often begins rapidly to understand what may have been incomprehensible in the past. He seems to have one "Ah-ha, so that's what it means!" experience after another. For the worker, Stage 7 may represent his most exhilarating moments.

At Stage 7, the worker is really exercising his cognitive skills. Accepting one challenge after another, he generally achieves many consecutive successes. More often than not he experiences a sense of elation generated by a continuous stream of successes. With every new success, he steps closer to the next stage, equilibrium.

At Stage 7 you will guide your staff very little, if at all. You will invariably play two roles: observer and validator.

Recognize each of your staff's achievements. Although a staff

member may know he is doing a good job, he still needs your validation. When you notice and comment on his good work, you are expanding his self-esteem. Perhaps success breeds success, but recognition breeds self-esteem. It is always prudent to remember that, for him, you are an important source of his job security.

Stage 8: Equilibrium: a new office routine: In a traditional office, the worker primarily utilizes the "free space" approach to tasks — he believes he can organize tasks and control their routine performance. He can, in essence, modify what he is doing. Whether this feeling is accurate or not is irrelevant. What is important is that he feels in control.

The worker in an office of the information era utilizes, to a greater degree, the cognitive approach to tasks — he abstracts tasks in order to perform them. To do this, he needs a thorough understanding of his job. While he develops a cognitive approach, he generally feels he has lost some control. This feeling is temporary. He frequently senses he is somewhat less competent to perform his regular job, also a temporary feeling. He often feels tied in a knot by the computer that sits on his desk and waits for his commands.

But the more he understands his system, the more he internalizes that he, in fact, controls it. The more he uses the system, the more he realizes he is performing his job more thoroughly, more accurately and in a more timely fashion. Most workers discover they have time left over; they have free time. In effect, the system has become an ally. When this happens, most want to establish new office routines based on *their* requirements, not the computer's. To each worker, this really means, "Okay, I'm the one in control again." He has made a major shift to new routines. He has steadied himself. The worker has struck an equilibrium. His equilibrium is a firm base from which he can make minor adjustments in the future.

Tools and Crutches

Your staff will let you know when they are ready to accept computerization as their new office routine. Be alert to their signals. The first sign of their readiness is a request to establish new routines. If you are sensitive to their first signal, you can enhance their satisfaction and maintain the glow of success.

Respond to their first signal by giving them a scheduling pad. This is an effective tool that helps them understand the whys and hows of scheduling in a computerized office. It also forces them to agree on some logical scheduling compromises each will have to make. After doing this, they will be able to run their own offices again.

Give each member of your staff a "What Were You Doing?" pad, which allows them to list all the possible tasks they could have been performing before being interrupted. When they return, they can use this pad to recollect the task they had been performing.

Your staff is using new skills. Give them as many crutches as you can so they can exercise them with greater ease and satisfaction. After their system becomes second nature, these crutches will not be so useful.

Last but not least, let your staff know they've come a long way.

New Paradigm

Computers, those 20th-century mind-levers, have proliferated by the millions, thrusting the uninitiated pell-mell into the information era. Managers in offices across the country are faced with a new set of problems. They are faced with these problems whether their office is large or small, whether their staff is brilliant or average, whether their staff loves or hates the computer. Frequently, managers respond to these problems like the five blind men in the ancient fable who experience only part of the elephant and think the part they feel is the whole elephant.

If the staff initially resists the changes introduced by a system, they more often than not exclaim, "My staff won't try anything new. I'll have to lay it on the line!" If their staff stumbles trhough the first few stages, managers may lose heart in their staff's ability. These managers have identified part of the problem as the whole problem.

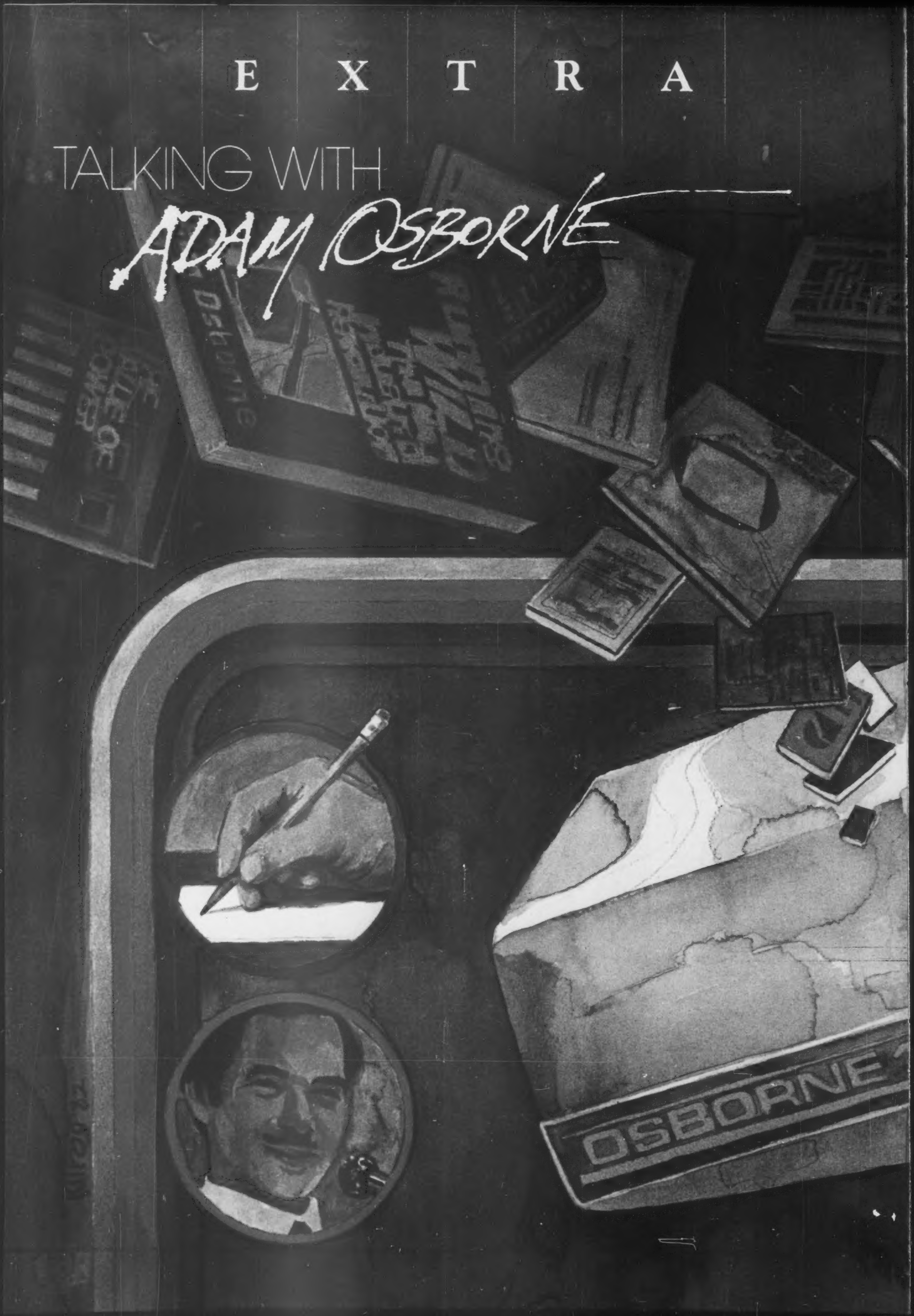
We propose a managerial paradigm that recognizes staff reactions not as problems, but as necessary stages of the Psycho-Computer Syndrome. If you study its pattern, you can equip yourself to deal with one of the challenges you will encounter as you enter the information age — your staff's evolution into information workers. ◆

Perhaps success breeds success, but recognition breeds self-esteem.

The Guarnieris are principals in Automation Management, Inc., which is located in Richmond, Va.

E X T R A

TALKING WITH ADAM OSBORNE



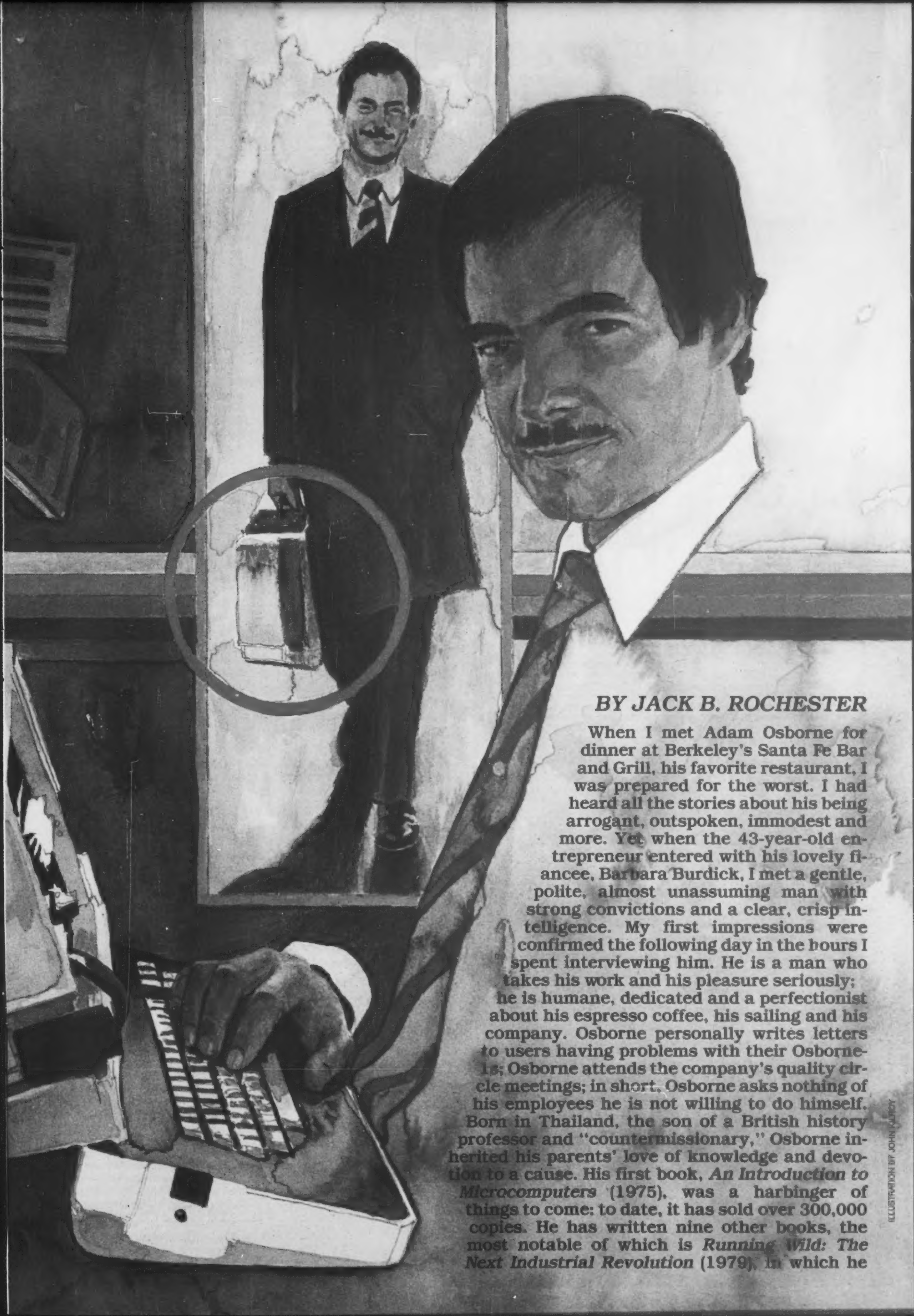


ILLUSTRATION BY JOHN KILROY

BY JACK B. ROCHESTER

When I met Adam Osborne for dinner at Berkeley's Santa Fe Bar and Grill, his favorite restaurant, I was prepared for the worst. I had heard all the stories about his being arrogant, outspoken, immodest and more. Yet when the 43-year-old entrepreneur entered with his lovely fiancee, Barbara Burdick, I met a gentle, polite, almost unassuming man with strong convictions and a clear, crisp intelligence. My first impressions were confirmed the following day in the hours I spent interviewing him. He is a man who takes his work and his pleasure seriously; he is humane, dedicated and a perfectionist about his espresso coffee, his sailing and his company. Osborne personally writes letters to users having problems with their Osborne-1s; Osborne attends the company's quality circle meetings; in short, Osborne asks nothing of his employees he is not willing to do himself.

Born in Thailand, the son of a British history professor and "countermissionary," Osborne inherited his parents' love of knowledge and devotion to a cause. His first book, *An Introduction to Microcomputers* (1975), was a harbinger of things to come: to date, it has sold over 300,000 copies. He has written nine other books, the most notable of which is *Running Wild: The Next Industrial Revolution* (1979), in which he

Talking With Adam Osborne

made many observations and predictions about the computer industry. Chief among his criticisms was the fact that microcomputer companies were following a poor example set by mini- and mainframe firms, failing to deliver personal computers at reasonable prices to the public. He went on expressing his views in a column for *Infoworld*, CW Communications, Inc.'s microcomputer newspaper, and other publications as well (his last article for *Infoworld* appears on Page 21). Eventually, Osborne determined he should practice what he preached and founded Osborne Computer Corp. The prototype Osborne-1, exhibited at the 1981 National Computer Conference in Chicago, was scoffed at. I described it in CW at the time as looking "crude and unattractive." Yet the critics, myself included, have been vanquished; not only is the production model handsome, it will sell to the tune of 150,000 units this year. The industry has been quick to note the promise of a portable computer, and the Osborne-1 has many competitors. But the real story is of Osborne the man. As I settled myself on the sofa in his office and he poured espresso for us, I asked how he became interested in computers.

Your first job wasn't in computing, was it?

No. I chose chemical engineering for a very good reason. I liked chemistry and math and I didn't have that many choices. I went to university in Birmingham [England], then came to America in my last summer as an undergraduate, which was 1960.

I was mesmerized by America as soon as I came here. I realized I had always been an American and never knew it. I loved the free-flowing vigor of the place — the fact that nothing counted here other than achievement and performance. Brashness was almost encouraged, provided it was backed up with some substance.

My brashness got me into a little bit of trouble. I was supposed to settle in as a junior engineer — I was working for M.W. Kellogg — and was anxious to do a bit more than that, so I didn't get on very well. I moved from engineering to thermodynamics, where I did a bit better, but I decided I'd go get myself a Ph.D, so I entered the University of Delaware in September 1964. I got my master's, then my Ph.D., and then a job with Shell Development Co. in Emeryville, Calif.

So here I was working for Shell, and before very long I was back into the same problem I had before — I was looking for something a little more than a job. I was very brash, which didn't sit well in a large corporation. Shell was closing up Emeryville and moving to Houston, and they suggested that I very seriously question whether I should be moving to Houston with them. Having thought about it, I reealized I shouldn't.

At that point, I realized the problem wasn't Kellogg's or Shell's, it was mine. To work for yet another company as an engineer didn't make any sense, because I'd just be repeating the pattern. I decided to work for myself instead, and I hit the sidewalks.

What did you think you might do?

Originally, my idea was to be a programming consultant. I was very familiar with programming from graduate studies, and when I went to Shell I had done very mathematical models of chemical plants, tying all these chemical calculations together.

However, that was the summer of 1970, which was quite the most grinding recession this industry had ever seen. There were programmers committing suicide trying to find work, and for six months I couldn't find a job. Therefore, as a programmer I wasn't going to do very well. But I come from a family of writers and I've always been a writer myself. I discovered technical writing.

Lo and behold, I realized very quickly that technical writers were the armpit of the industry, and the computer industry treated them very badly — paid them slave wages and treated them with scorn and disdain. If you had the rank of technical writer and you were demoted, I suppose the next place down was janitor. I'm not sure there was anything much in between. As a result, most technical manuals were truly bad documents, which meant that I found I could pick up technical writing jobs and whip them out in no time at all. In that fashion, I developed a small company that was 75% technical writing and 25% programming.

Technical writing gave us the cash, and programming the prestige. In 1972, after having been in business for about a year, we picked up the account for all the technical writing for General Automation, Inc. Being a three- or four-man company at the time, we had to hire a few additional people and get a bit more business-

like. By 1974 I had a nice little company called Osborne and Associates with 15 or 16 people. Most of what we were doing was small business systems programs, but all the money we made from technical writing we lost on those programs.

Well, in 1974 we went into the next recession, and that hurt General Automation very badly. There was a huge management shakeup and all the people we had been working with were thrown out, us along with them. I was getting very disillusioned with technical writing. We would produce a document and it was almost axiomatic that if the document were to succeed in the field, it had to receive bad reviews from engineering. There was no way you could win.

I decided this really wasn't a good business after all, and the programming had certainly not proved good business. What I needed to do was try something else. I'd done a lot of writing for microcomputer and microprocessor manufacturers, so I decided I'd go into microprocessor consulting. In order to differentiate myself from all the other microprocessor consultants, I wrote a book called *An Introduction to Microcomputers*, which I intended to self-publish. I put a price of $7.50 on it and figured I'd sell a few and give most away.

But I got a call in December of 1975 from IMS Associates. They wanted to know if I had any copies of *The Value of Power*, a book I'd written for General Automation. This was the book my *Introduction to Microcomputers* was actually modeled on, in terms of format and style. It seems they were making a computer kit and wanted to put in that sort of book so people would understand what it was all about.

It's a funny thing, but I had *Introduction to Microcomputers* due out in a week. I took them a manuscript, we haggled on price and they phoned in an order for 10,000 copies. I decided they were either out of their minds or onto some new aspect of the industry I had never heard of before. The latter was the case.

It was the first and only book on the market and the copies were just gobbled up. I decided this was the business really, rather than consulting. I printed 10,000 more, converted it into Volumes 1 and 2 and was in the publishing business, which I had pretty much to myself in early 1977. In 1979, McGraw-Hill bought the company because we were doing quite well.

So you were now in the publishing business.

Yes, and in 1976 I started writing my "From the Fountainhead" column for *Interface Age* magazine. That column was initially supposed to be just a regional report on northern California, but it quickly developed into a lot more. I started taking potshots at some things, some of which I shouldn't have. For example, I discovered that a lot of kit makers were buying reject parts to make their kits cheaper, so the kits wouldn't work. Hobbyists would assume they themselves had clobbered the part.

From that I went on to look at all kinds of other frauds. I discovered a lot of companies were advertising products they didn't have, while they were telling people to send in their money. The companies would cash the checks and then try to build the product. I went after that one and before very long had become a little bit of a folk hero among users and a little bit of a bastard among manufacturers.

So you actually became an industry observer.

Well, I did get a tremendous amount of input. I saw what was selling and what was doing badly. I saw the mainstream of the business develop. I saw CP/M, C Basic and M Basic emerge. I saw companies fold simply because of lousy management. I'd go out and talk to some of these people and I couldn't believe what I'd heard. They wouldn't admit luck had anything to do with where they were. It was their brilliant acumen.

Within this scenario we saw the emergence of a few well-run companies, like Apple. They had an off-brand product and an idea that was out of mainstream, which succeeded simply because people wanted something reliable. Radio Shack's product was adequate. Of course they are a big company. Commodore was a moderately stable company, but was selling mostly outside the country.

By 1979 the mainstream of the industry had all but disappeared through bad financial management, and there was nothing left but those on the periphery. Apple, Radio Shack and Commodore, which did not represent the mainstream, knew little or nothing of where the microcomputer industry had come from. They were now rapidly turning their backs on all of the industry concepts and becoming minicomputer-like companies.

"Hey, this is ridiculous," I thought. The solution was obvious: Come out with a very inexpensive product that was industry-compatible in hardware and software and then just carry on the momentum we had before, as Imsai or North Star or Vector Graphic had done.

Did those companies have compatibility?

They would have all had compatibility. They were Z80-based products that looked the same and ran the same software. And Apple would have never gotten off the ground.

It wasn't that the others were dishonest; they were just disorganized. The Apples and Radio Shacks were able to behave with fiscal responsibility, which is why they did well — not anything to do with the product. In fact, the product was wrong, but that was secondary. For a while, I told people what I thought they should build and nobody did. So I built it. And that's the story.

Some say that in the American way of doing business, people tend to underestimate the importance of the product.

I think I've noticed that a lot of people's minds tend to ossify fairly quickly. The minicomputers of the late '60s weren't nimble-witted enough to see the micro come along. We are seeing the same thing right now with a lot of micro companies afraid to take the bold next step. It's probably the result of the industry's moving so fast that the people and their businesses don't have time to mature before the next wave comes along. Many of them won't survive, but I think the industry will start to stabilize within five to eight years.

What will it be like then?

You will have a broad spectrum of products, of course, but basically you are going to see computers sell very much like hi-fi systems — you turn it on and make it go. It's a useful appliance. It's cheap. It will come into the home, not to balance the checkbook, but as a word processor. Everyone writes letters. People will attach it to the telephone and it will become an electronic mail station.

What other technical revolutions do you expect?

I think the next big one is the one we were talking about at dinner last night, biological logic. I think the hurdles they'll face will be a little bit larger than the ones you thought of and it's going to be five years or more before they are able to build anything that's economic and useful. Computers will still be an appliance; they will never change the nature of human beings.

But how do we get people to embrace computer technology when it seems so many are resisting it?

It's going to be a combination of evolution and necessity. On the one hand, we will make these devices easier to use; on the other, the economic imperative of using one will help us. After a while, executives will discover they can't avoid using these devices — they'll just have to do it. And as they see themselves having to do it, they will also see products coming along which are even easier to use.

Will touch-sensitive screens or voice recognition systems make computers easier to use?

Nah, those are gimmicks. Hitting a key on the keyboard is an awfully simple way of doing things. The more gimmicky you get, the less interested I am. You have got to start with the bread and butter — word processing — and the rest falls into place very quickly. They find that, hell, this isn't such a big deal after all. I do a lot of word processing and electronic spread sheets. I haven't gotten much further than that.

Do you think we'll have more highly skilled people in the automated office of the future?

Much more highly skilled, because they are going to have to cope with these machines, and that means they must be much more productive. Clerical work will be a lot more challenging because people will be using fairly powerful machines to do relatively powerful tasks. As a result, there will be more competent people there.

Where will they be trained?

That's a problem. One area of education that is overlooked right now is the trade school approach to preparing office workers. Secretarial colleges should now be teaching a fair amount of computer literacy to students. A lot of junior colleges are doing it, but it's unfocused. There isn't a department that teaches you how to go into the office of the future as a secretary/administrative assistant totally familiar with the business machines of today.

How will we get good people?

At the moment, the problem is that people perceive themselves as not having any really significant demands made of them, and certainly no special recognition for their efforts. That's the problem, and it was summarized very much by a letter to Ann Landers I read. A teacher wrote in from some place that had had tremendous floods; she said she had been complaining for two years about these lazy truancy-happy students who do nothing but drugs and run off in the middle of the day to have sex. And then all of a sudden, there they all were, piling up sandbags and helping people in trouble. The moment there was any real demand made of them and they felt there was some point to it, they were out there doing it like anybody else.

That's the point: too many options and not enough recognition.

How about employee relations at Osborne Computer Corp.?

The one thing I'm trying to concentrate on here is the concept of the team spirit in corporations. I believe this is the secret of Japan's success: Everyone from janitor to president feels they are working on the same team because they are going to be mutually rewarded. In America, too often company management is interested in rewarding company management and stockholders, while employees have to fight for everything they are going to get. You get an antagonistic situation, which results in collective bargaining. That's wrong. What we need to do is a collective corporation.

How did you come to this point of view?

I have felt it for a long time and have seen the effects of management style from working in large companies. I've been on the receiving end of it most of my life, and I've seen that the people around me would have been happy, would have given their best efforts, if they felt anybody gave a damn or would listen to them. So I give a damn, I care, I listen and I make sure everyone gets rewarded. We give stock options to everyone, not just to senior management. We give bonuses to everyone, not just to senior management. I'm establishing quality circles. I go around the shops myself. I encourage people to come talk directly to me. I've told people in the shop, "If you wouldn't buy it, don't pass it."

Where have you established quality circles?

Everywhere. Production, quality assurance, employee relations and morale and customer relations. In each quality circle we have five people from the different groups of the company, and they talk about what goes on and bring up problems. Somebody from the dealer customer relations area says, "Hey look, you guys in production are causing this kind of problem," and the people in production will say, "Well, this is the problem we are having from our end." They talk to each other and eventually they identify a problem they can bring to my attention. They are required to send me a memo following every meeting, and I've informed everybody these memos will have the weight of managerial decisions.

According to Business Week, *you will not always be involved at Osborne Computer Corp.*

I said I am keenly aware of the fact that there are entrepreneurs who can drive a company into the ground as fast as they build it up, and I'm an entrepreneur. If I cannot change and run a large company I'll move on, but I'm sure as hell trying to change and stay.

Are you planning to change your maverick image as well?

Being a maverick involves saying more of what I mean at any time. I

Adam Osborne's Final "From the Fountainhead" Column

In this last column I will explain why I started a new company, and why I chose to build a new microcomputer.

The microcomputer industry has lost its momentum. It is no longer living up to its potential.

Our industry has come a long way since I wrote my first "From the Fountainhead" column for *Interface Age* back in 1976.

The popular press likes to identify the present leaders in the microcomputer industry as farsighted geniuses who either invented the microcomputer or designed the best products. That is rubbish.

Apple, Commodore and Radio Shack never were innovators, and yet the microcomputer industry was born of innovation. The early amateurs were innovators, which is why some of them survived, despite their lack of business finesse. The innovators are gone; that is why the microcomputer industry has lost its momentum.

Apple, Commodore and Radio Shack are now building small minicomputers, complete with unique operating systems, unique programming dialects and unique application software.

'Truths'

These truths of the microcomputer industry need to be rediscovered: (1) we must build microcomputers that execute industry-standard software; (2) we need to continue driving down the cost of computing power, and that calls for new design concepts.

It is absurd when the industry leaders each produce microcomputers with unique operating systems, programming-language dialects and applications software. These stale old minicomputer-industry notions will cripple our industry.

The real mandate of microcomputer hardware manufacturers is to build machines that execute programs built by a broad range of software companies. That is the only way the microcomputer industry will live up to its potential.

Infoworld, April 13, 1981.

Executives will discover they can't avoid using computers — they'll just have to do it.

Talking With Adam Osborne

don't think I need to change the maverick image in order to run a sound company.

In your book, Running Wild, *you said there are places we shouldn't use computers.*

Yes. In balloting, for instance, I just feel that the slightest chance of fraud isn't worth it. If we are going to spend a little bit more money for counting or if we have to wait longer, fine. We all know that rigging is possible — it's very easy to do. It's not the outsiders I'm worried about, it's the people running it.

Electronic funds transfer is the next place where I have lots of problems, because the potential for fraud is going on all the time. I've heard of banks that are doing funds transfer on public-access networks. Two years ago, I issued a public challenge to any bank that would guarantee in writing not to prosecute me that I would steal $10 million from them via wire fraud. We weren't actually going to rip off the bank; in fact, we were going to call the bank president and ask him to come and get his money. We'd have a $10 million cashier's check waiting for him. Of course, no bank took me up on the offer.

As for the stock exchange, my God! — there has never been an opportunity for fraud like that. Who is going to count the shares? Who really knows who owes what? The auditing problems are a total nightmare.

I think it's madness. The fact that my views are not widely shared isn't going to stop me from having them. The point is, I'm not going to make a career of going out and doing something about all this. I've got too much else to do.

For example?

Well, I've got the novel I'm working on. I'm very concerned by the possibility that our present is one of historical transitions where the freedoms and democracy we have are not by any means a steady state, and that we are heading right back into an autocratic world devoid of freedoms. The reason for this is that the majority of the population cannot cope with freedom. There are too many choices, and they are frightened. We now see a few kids running off to join the Moonies or some other group that will make all their decisions for them.

And after we've had two or three or four more recessions, someone who thought he was set for life will find he is suddenly out of work and joining a bread line. One day people will start saying, "Heck, you know, I'll give up my aspirations for the future for the guarantee that I can keep what I've got." When that happens, you are in for an autocracy. At that point, people will vote for anyone who will say, "I will make your life secure."

The story begins sometime in the late 21st century, when the only countries left which are democracies are the U.S. and Canada. When the U.S. goes autocratic and they get rid of the one man, one vote, it all becomes a hierarchy and the corporations run the country. The liberals and democrats are pushing defense spending and aerospace spending all they can because it's a hostile world.

We build a couple of star ships, which go into mothballs, because nobody wants to go into space. But then the democrats take off with the two star ships and head for where they can find another life. They settle down and colonize and 500 years later, when they've developed the ultimate democracy, they come back to Earth — which they haven't communicated with for hundreds of years — to learn what's going on. They find this static society — a total anarchy. There is no law, but there is a caste system.

But there is nothing more boring than an author telling you about the novel he's writing.

Aside from the novel and the Osborne-1, what's next on the horizon for you?

Don't know. If I had any idea, I'd be doing it. ◆

BEHIND THE FIFTH GENERATION

A PERSONAL VIEW

第五世代の後に

個人的見解

The notion of a Japan, Inc. operating all the way down the line is really a B-movie image.

I went to Japan for the better part of a month to isolate those elements of the Japanese character and methodology that might make the fifth generation possible. This, then, is a non-Japanese view, a view of one who, over the course of the year preceding the visit to Japan, had read every bit of fifth-generation literature he could find.

On the one hand, it is perhaps a skeptical view; on the other, it is also more encouraging, for, in a sense, the fifth generation can be said to have succeeded already. Indeed, since the project was announced, it has become almost impossible to have a discussion with any computing professional about the next 10 to 15 years without Japan and the fifth-generation project entering the conversation within the first five minutes.

We begin here, however, with the following facts:

• Work on the fifth generation has now seriously begun. The almost ad hoc meetings of the last three years are over, money has been allotted, a research team has been brought together and that team knows what sort of system it is initially setting out to build (see Figure 1 on Page 25).

• The fifth generation depends on substantial advances in very large-scale integration (VLSI). Those advances are coming. As I write, a megabit read-only memory (ROM) sits in front of me on my desk, and the megabit random-access memory (RAM) is probably not much further away than two to three years.

• The Japanese study of devices is important and has radical elements to it, elements worth thinking about further. We shall return to those.

• The Japanese have systematically and correctly identified some key areas in need of further advances to make the fifth generation possible. In many of them, research and development is already well advanced.

• The fifth-generation program is not the only advanced program in progress. The Japanese are committed to a supercomputer project that will have a radical impact on the future of computing, whether or not the fifth-generation project succeeds. Long before that, Japan will have introduced many other "giant" computers. As much supercomputer development

BY REX MALIK

CALLIGRAPHY BY MORITOSHI KAJIZUKA

is probably in process in Japan as on the rest of the planet put together. At least four systems aiming at Cray 1-equivalent power or above are now under development. Three of those are scheduled to be announced and delivered within the next two years.

• The Japanese are already looking beyond the fifth generation. Next on the schedule is a project straight out of science fiction, the intelligent robot. It will begin in 1983 with funding of $70 million.

Fifth Generation

On the first of June, after about three years of discussion, the Institute for New Generation Computer Technology (Icot) formally came into being as the staff walked through the door and began work. Today there are about 50 researchers, all operating from the 21st floor of a major bank building in downtown Tokyo. The location in a bank building is entirely appropriate because the real costs of the fifth generation will be huge and will go far beyond any costs so far announced.

The fifth-generation project depends heavily on R&D being done under other headings, separately funded by government and the eight electronics companies involved. Icot will have close links with many other research projects, most notably those of the all-powerful Ministry of International Trade and Industry (Miti) and its Electrotechnical Laboratory (ETL) at the "Science City" of Tsukuba, where much of the device and sensor research that must be done before the fifth generation can reach its full flowering is being carried out.

The fifth generation will herald a number of revolutions. Not the least of these will occur in Japan, and that process has already begun. The researchers, including Research Director Kazuhiro Fuchi (who came from ETL), and the team's key specialist in architecture, Dr. Uchida, are young. They are in their 30s, and the team that surrounds them is even younger. The handful of the elderly connected with the project — and the driving force in setting it up — sit on committees peripheral to the project's achievement. Prof. Tohru Moto Oka of Tokyo University; Takuma Yamamoto, president of Fujitsu, Ltd. and Icot's current chairman; and Sozaburo Okamatsu of Miti, all say the same thing: This is a young man's project. It requires new ideas. If they have to break with Japanese custom, with age seniority, to achieve their goals, then so be it. They do not put it quite so bluntly as I have — that, too, is Japanese custom — but their meaning is clear. One could reflect that, given the ambitions of the project and the time it will take, those undertaking it had better be young at the start if they are to see it through. But that would perhaps be too cynical.

Icot's first product is due in three years or so, a data flow machine in some form of VLSI, an extended, though still sequential, Prolog engine. It is going to take some time to design because many subsidiary areas need further research. Much of what passes for software will in fact be in VLSI. Fuchi expects to have a fifth-generation personal computer within three years. It may have limited capability, but it will take its place within the ancestry of the ultimate fifth generation. It will be the development tool on which fifth-generation ideas and proposals will be tested.

The ideas are still sketchy, for the institute is still very new. So new that at the time of this writing the first year's budget (Yen 423 million or roughly $1.75 million) had been assigned, but the method by which it was to be disbursed had still not been worked out. In the second year, if it can win its budget battles with the Finance Ministry (the Japanese have these battles, too), Miti expects to spend about $40 million.

Ultimate Systems

The Japanese ambition is to build systems that have built-in problem-solving and inference functions, manage their own knowledge bases and present intelligent interfaces to the outside world.

How will Icot go about this? And why will they start with data flow and Prolog? In the case of data flow, all the participants are fueled by the beliefs that von Neumann architecture has been taken as far as it can go and the architecture of the future is a parallel one. We can achieve systems that show some signs of intelligence, as humans understand it, only by going parallel. "Turing was right for the times, but the times are changing," Research Director Fuchi said.

"We are setting out to create what could be classed as special-purpose machines. If you go that route, you are free from compatibility problems," Uchida stated.

"I do not think data flow is necessarily the final solution, but it is a good candidate," Fuchi added.

Speaking of Prolog, Fuchi contin-

Machine translation system
- Translations among multiple languages
- Vocabulary size: 100,000 words
- Machine to guarantee 90% accuracy, with remaining 10% to be processed through intervention by man.
- System to be an integrated system where computers participate in individual stages ranging from text editing to printing and of translations.
- Total costs involved to remain at 30% or lower than for human translation.

Consultation systems
- Specimen applications
  - Medical diagnosis
  - Natural language comprehension
  - Mechanical equipment computer-aided design
  - Computer user consultation
  - Computer systems diagnosis
- Number of objects: 5,000 or more
- Inference rules: 10,000 or more
- Semi-automated knowledge acquisition
- Interfaces with system: Natural languages and speech
- Vocabulary size: 5,000 words or more

Chart Courtesy Miti

Figure 1. Subjects and 10-Year Targets for Basic Applications Systems

ued, "It is not Prolog itself which is interesting, but the logic on which it is based. It overcomes the deficiencies of Lisp and its basis on deterministic logic, without provision for alternatives. We can now afford to build a machine based on the predicate calculus."

Fuchi is in the driver's seat, and this enables him to say what programming purists have been saying for the last quarter of a century. Furthermore, he means it:

"We should be able to write programs as if there were no speed or resource constraints. The programmer should not have to worry about resource allocation; he should just be able to write his statement and not have to pay any attention to the machine." At one level, Fuchi knows he is setting out to devise that very machine. And he knows something else. The young may be in charge, but to make that statement in public, he has had to go through the processes leading to consensus. Everyone is committed to these viewpoints.

Another echo of that consensus could be heard at the Electronics Policy Division of Miti when I questioned its head, Okamatsu. Okamatsu is the chief promoter of the fifth generation; he has to fight the budget battles. He made it quite clear he expects the fifth-generation project to receive the funds it needs, however much they may be. If something has to give, it will be funds allotted to the support of other programs. Building a consensus in Japan is absolutely critical to change and to progress.

Building Blocks

But what will be used to build the fifth generation? Within this three-year time scale, probably silicon. Some Japanese would like to see how far silicon can be pushed. But will it be silicon in the long term? What will be the building blocks for the systems built five to 10 years from now?

The argument raging in electronic Japan today is not between the advocates of silicon and everything else, but about everything else. The agreement seems to be that, although silicon might provide the bedrock technology of conventional computing as far forward as we care to look, it will not do for the new devices the Japanese want to build.

On one side are the advocates of the Josephson junction, on the other, those for gallium arsenide. Gallium arsenide will not give the speed of the Josephson junction, but it does have the characteristic that it can still operate with speed improvements at ambient temperatures. The argument is further complicated by the presence of Fujitsu, which is pushing for its variant of gallium arsenide, which it calls High Electron Mobility Transistor (Hemt). Hemt has one characteristic: Although it needs to be cooled to achieve improved speed, it does not need cooling to the same near-absolute-zero temperature of the Josephson junction.

Means Toward the End

"I think the fight comes down to a choice between Josephson and Hemt for numerical calculation and fast processing, with gallium arsenide being clearly practically superior for image processing," Moto Oka said. Image processing is a key Japanese preoccupation.

Moto Oka was the father of both the fifth generation and the supercomputer projects, and his views are crucial in the choice of gallium arsenide

"We should be able to write programs as if there were no speed or resource constraints."

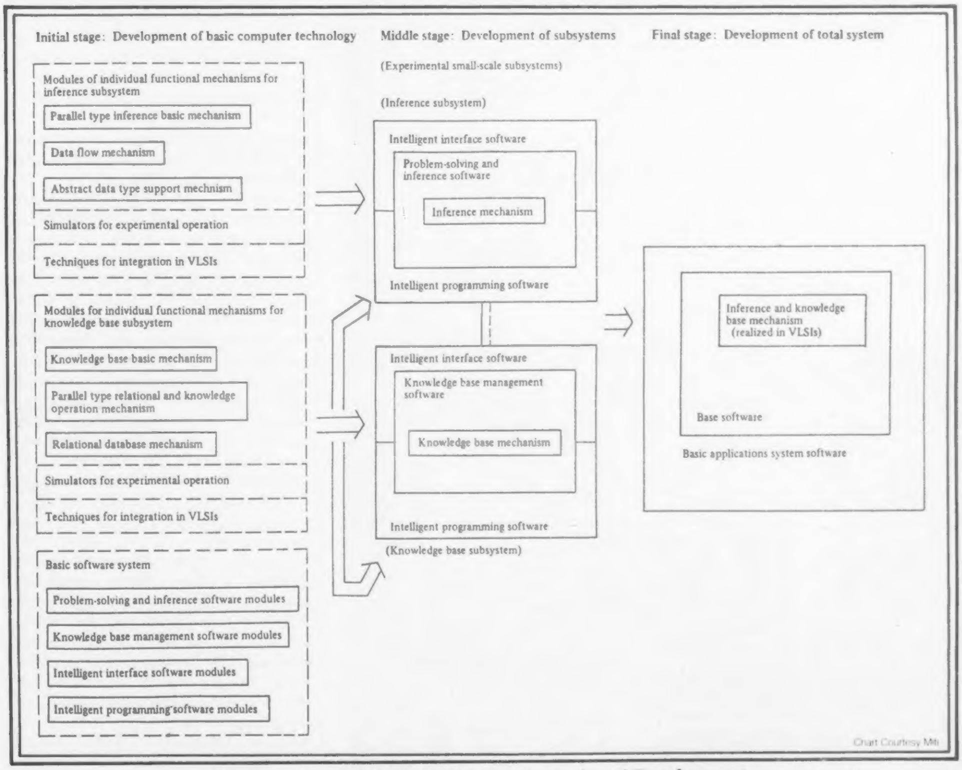


Figure 2. Stages of Fifth-Generation Research and Development

的見解

or Josephson junction. The argument over choice of devices is a serious one, for two very basic but dissimilar reasons.

One is almost a question of philosophy: "The strength of the Japanese electronics industry is in cookery. They will take devices and tinker with them, seemingly without end. They will stretch them in all possible ways until they find something that can be made to work, which has the right economics to it and which the market will accept. And the Japanese know that this is where one of their major strengths lies, which is why they have these arguments," said Dr. Graham Marshall, the British Embassy's scientific counselor and an electronics specialist regarded by many as one of the best observers of the Japanese electronics scene. The Japanese approach is the reverse of the American or British, which would take a systems or top-down approach. The Japanese build from the bottom up. After tinkering with the components, they then see what can be built.

The second reason why the choice of device is important is different from the first and will lead into some quite complex territory. It can perhaps best be stated in the form of a problem. What the Japanese have postulated in the fifth generation and the supercomputer project are systems as much as 10 times faster than the speed they expect from the current devices.

However, that statement assumes the systems are based on von Neumann architecture, and the one thing everybody is quite clear about is that they are not building such systems. All the Japanese research experimentation is now into parallel architectures of some type. If you cannot expect the speed from the existing architecture with new devices, then the architecture itself needs to be changed.

But that's not all that needs to change. Two other possibilities are:

• Don't simply change the hardware architecture, but change the total systems architecture and microcode as much as possible. (We shall return to this.)

• Look even more fundamentally at the devices themselves. Is it possible the limitations of silicon, to say nothing of the new devices, are limitations of perception, rather than limitations inherent in, for instance, silicon itself? We build these components out of a planar technology; that's the way we know how to build them. But is technology fundamentally limited to a planar technology? Are solid-state electronics essentially limited to two dimensions? Obviously not. Three-dimensional solid-state electronics has long been a feature of science fiction as well as science. Some engineers at Plessey, the British electronics group, were thinking on three-dimensional lines as early as the late '50s, when they were told to drop those wild, way-out ideas and concentrate on something more immediate.

Three systems of Cray 1 performance or better are under commercial development, and all are due to hit the market within the next 18 months: One, from Hitachi Ltd., is a general-purpose processor with an integrated array processor; one is from NEC, a pipeline machine; the third is from Fujitsu and is claimed to be a twice-Cray-1 performance processor, which is scheduled for delivery in the winter of 1983-1984.

Fujitsu is also building a fast Fourier transforms front-end to a Fujitsu GP 280 for Japan's Nobeyama observatory, a 1,000-element VLSI box to search for low-level signals.

There also seems to be an interesting but shadowy project in the background, an experimental supercomputer of von Neumann architecture, which tries to stretch silicon to its limits. It is variously described as being of anything from one to 100 times more powerful than the Cray. Part of the reason for this independent project is said to be that Fujitsu is playing long-term politics. Fujitsu is said to be betting it can pursue development beyond the rest of its competitors/ collaborators — so that whatever finally appears on the market as the Japanese supercomputer, Fujitsu will end up making it.

Earlier this summer, NEC announced the results of a Cobol experimental machine implementation, a medium-scale general-purpose processor with a Cobol machine attachment (the Cobol architecture is called Combat), which is the result of studies they have been doing since the mid-'70s.

The paper that announced the results claimed the machine "considerably reduces the amount of memory required for machine instruction storage. Experimental results show a reduction of between 17% and 36%. Furthermore, the architecture reduces object program memory access frequency by 25% to 44%. "Overall program execution time for the combined Cobol machine and a host processor is improved 1.2 to 3.5 times."

Its chief architect, NEC's Mamoru Umemura, said simply, "The more complex the statements, the faster the gain." If genuine (and I have little doubt it is, even when you read the small print and the qualifiers), that is a substantial set of performance improvements.

It is also axiomatic that fifth-generation systems should be, to use the current cliche, "user-friendly." Much of the current long-term research, therefore, is into vision systems and voice systems. When questions are raised about problems in those areas, they reply that the answer is 10 years out — which is the Japanese way of saying, "We know this has a solution, but we do not know when it will come. All we can say is that we do not think it is short term and within commercial development time scales."

Why this emphasis on vision and voice? Because the Japanese office is generally still a nightmare. In addition, there is no real-time typing and everybody wishes there was. So the target remains the recognition and analysis of continuous speech.

Reaching a Consensus

What one cannot fail to note is that Japan's R&D programs are usually the result of a consensus. How is this consensus reached? A large part of the decision-making elite — academic, government and corporate — went to Tokyo University. In Japanese social organization, the peer group — the university class — tends to exert immense influence in later years. The class meets and socializes almost ever after, which means that the senior electronics men, the senior bureaucrats, R&D men and those who become professors tend to meet and talk and drink together in the evenings. Instead of going home, they hang around in bars. And what do they do? They dream up projects. Certainly the optoelectronics project began its life as an evolving set of discussions over drinks spread over many evenings. But, bars or not, will Japan make it?

As I left Japan, the first news was coming through of what has already undoubtedly become known as Japanscam, the arrests of Hitachi and Mitsubishi staff on charges of industrial spying. We should be wary of falling into the trap of thinking that this sort of activity accounts for the strength of electronic Japan.

This is not the only spying that goes on. I know of Japanese who are doing that in the UK, as I know Englishmen and Americans who are doing that in Japan, quite legitimately. I also know Japanese who think one of the main tasks of IBM Japan is to watch as closely as possible developments in the home-owned Japanese industry — again, quite legitimate.

None of this should be allowed to obscure genuine advances Japan has made in the last decade. Some have said the Japanese challenge has not yet really materialized because the Japanese are the world's best copyists, not originators. I believe they are the world's best copyists, but this is not by any means the whole story.

A look at the mainframe business will tell you Japan has not been in it for very long. Fujitsu did not build its first large mainframe until the end of the '60s. This is simply not long enough to make the advances and mount the serious across-the-board challenge one eventually expects to see.

I take little comfort from either the past or present of other industries into which the Japanese have moved. I remember hearing statements from industries in the U.S. and Europe — camera, watch, tape recorder, television, hi-fi and automobile. Their investment over the long term; their skill and expertise; the existing market base, distribution networks and customer loyalties — all this, they claimed, would see them through the Japanese challenge. They seemed to be saying that there was something special about their industries that the Japanese would not be capable of either copying or improving upon.

They are not saying that now. Indeed, some are no longer around as effective market forces to say much of anything.

I look at that NEC megabit chip on my desk and remember the late '60s when it was just a dream. It was axiomatic then that someday that chip would materialize and just as axiomatic that it would materialize first in the U.S. Anything else was inconceivable. Had someone said to me then that it would have come first from Japan, I should have laughed.

I am not laughing today. ◆

Malik, a veteran of more than a quarter of a century of computer journalism, is also a television commentator and author of several books. His next book, a study of the present and future impacts of computing on the industrialized societies — American, European and Japanese, is called Four Million Years Is Enough.

Three systems of Cray 1 performance or better are due on the market within 18 months.

Networking standards. Nobody keeps your options open like Digital.

By now, everyone understands the need for standard communications protocols. Without them, an electronic Tower of Babel would surely ensue. But there have to be different standards for different networks. A local-area network is different from a wide-area network. A public network is different from a private one.

No single universal standard has emerged. Nor is one likely to. There are simply too many diverse networking environments, each fulfilling specific, mutually exclusive needs.

That's why Digital is committed to supporting and, in fact, actively promoting the more important standards now surfacing in the various environments.

Our goal is to offer our customers a range of standards to achieve any combination of networking objectives. And we've been pursuing that goal for many years.

A forward-thinking strategy.

When we first developed our networking architecture, we understood the need for flexibility. We consciously adopted an architectural strategy that would allow our networking software to work freely with a wide range of protocols, including some that didn't even exist at the time.

The success of that strategy is now becoming apparent. As more vendors enter the networking field, Digital is uniquely positioned to offer compatibility with the emerging protocols. We've gone farther than anyone to assure that your options are open.

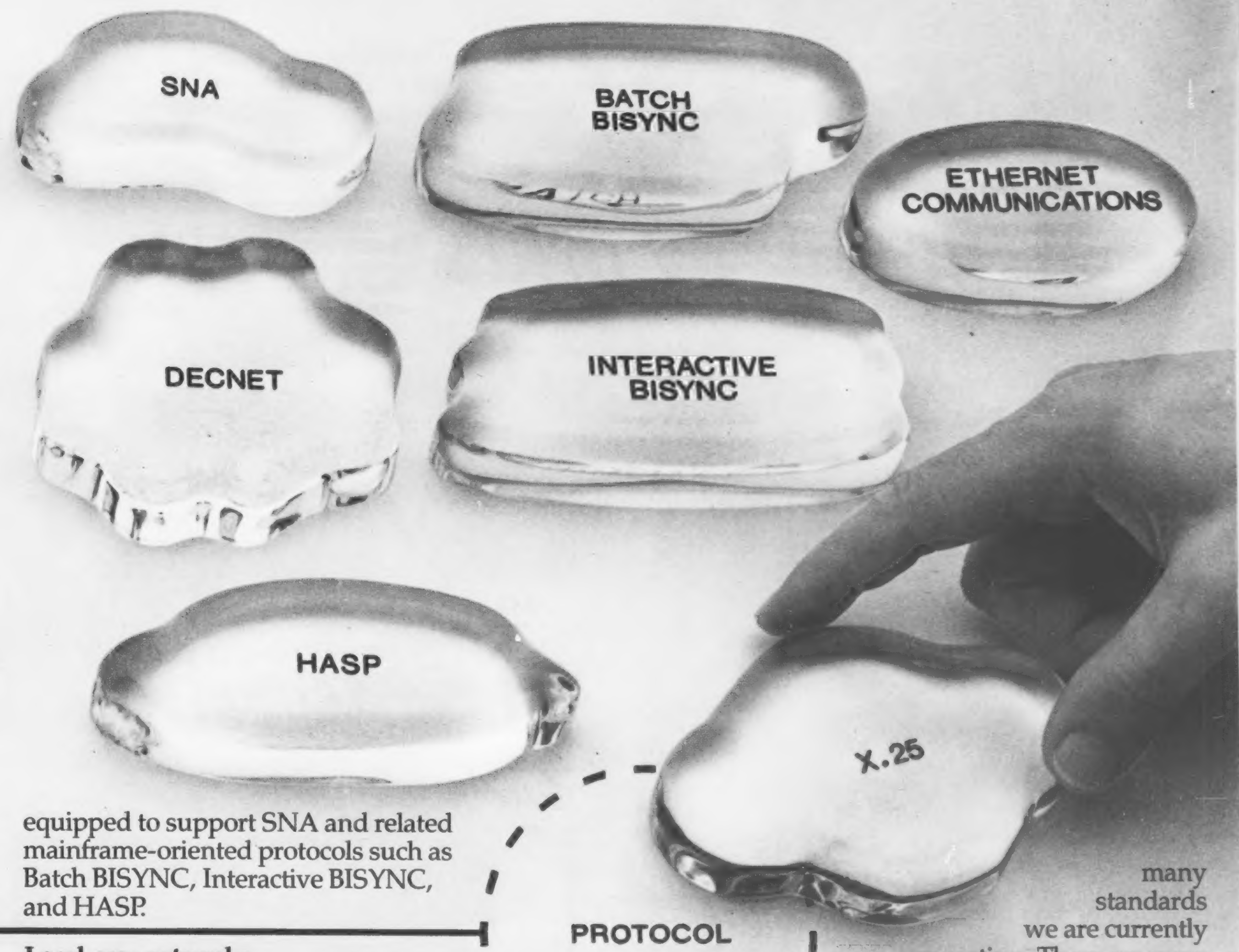
X.25 and other public networks.

Digital offers the X.25 protocol for use with public packet-switched networks such as Datapac (Canada), Transpac (France), and PSS (U.K.).

But when used with our computers, X.25 is much more than a simple link. We can provide you with the higher-level protocols that will take your systems beyond mere communications and into the sophisticated functionality that has made us a leader in networking software.

Hierarchical networks.

Even though we prefer to implement more flexible distributed networks, we are amply



equipped to support SNA and related mainframe-oriented protocols such as Batch BISYNC, Interactive BISYNC, and HASP.

Local-area networks.

Digital is one of the original sponsors of the Ethernet™* specification that has been adopted by a number of computer, semiconductor, and office equipment manufacturers. We recognized early on the need for highly reliable local-area networks. We were in on the ground floor of the definition, development and, now, the implementation of the Ethernet specification.

Distributed data processing networks.

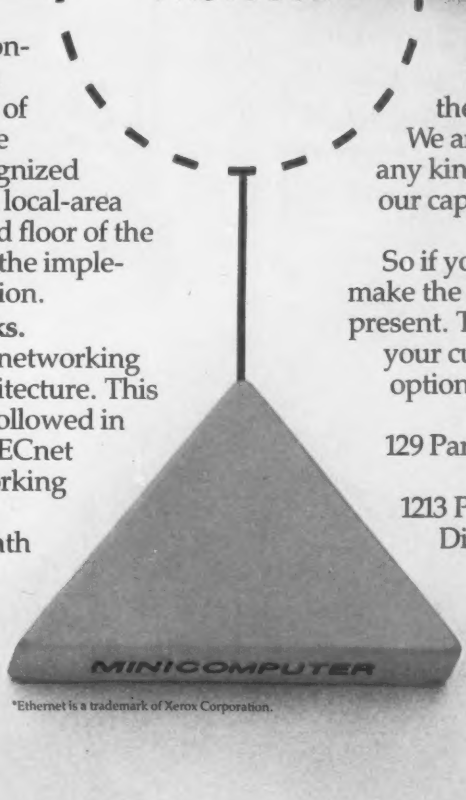
DECnet,™ Digital's proprietary networking software, is based on a layered architecture. This is the same architectural approach followed in the model proposed by ISO. Our DECnet offers a wide range of quality networking products, products that allow such sophisticated options as adaptive path routing, down-line loading, and enhanced network management capabilities.

And so on.

We have listed a few of the many standards we are currently supporting. There are more. But even more important than the number of protocols is the attitude we have toward them. We are determined to help you meet any kind of networking objective. And our capabilities in that regard are as far-reaching as they are farsighted.

So if you're planning a network, don't make the mistake of planning just for the present. Talk to the people who can meet your current needs and still keep your options open for the future. Talk to us.

Digital Equipment Corporation, 129 Parker Street, Maynard, MA 01754. In Europe: 12 av. des Morgines, 1213 Petit-Lancy/Geneva. In Canada: Digital Equipment of Canada, Ltd.



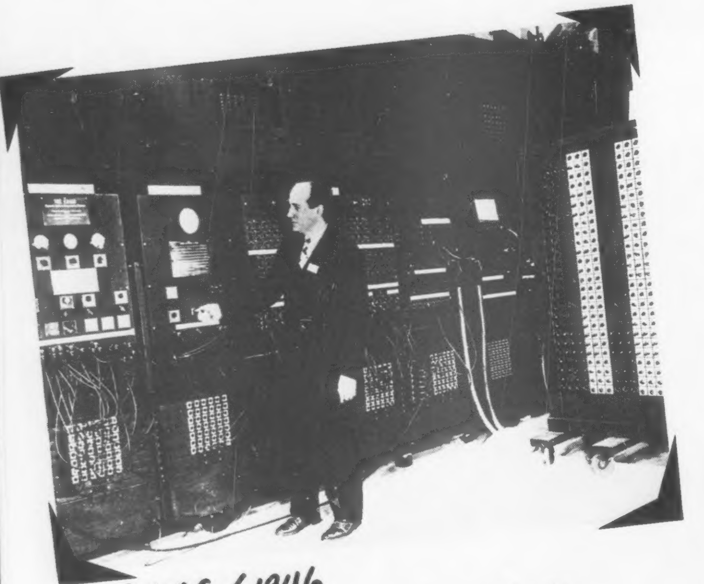
digital

We change the way the world thinks.

*Ethernet is a trademark of Xerox Corporation.

E X T R A

The World's Fastest



ENIAC / 1946
J. Presper Eckert demonstrates the Eckert-Mauchly machine at the Moore School of Engineering, University of Pennsylvania. It could perform 5,000 calculations per second

UNIVAC I / 1951
The first Univac was delivered to the Bureau of the Census in Philadelphia. Remington Rand (now Sperry Univac) immediately received orders for two more.

BURROUGHS UDEC / 1953
(Unitized Digital Electronic Computer) Installed at the Wayne State University Computation Laboratory

"A supercomputer is a computer that is only one generation behind the problems the customer is presently experiencing."

NEIL LINCOLN, Control Data Corp.

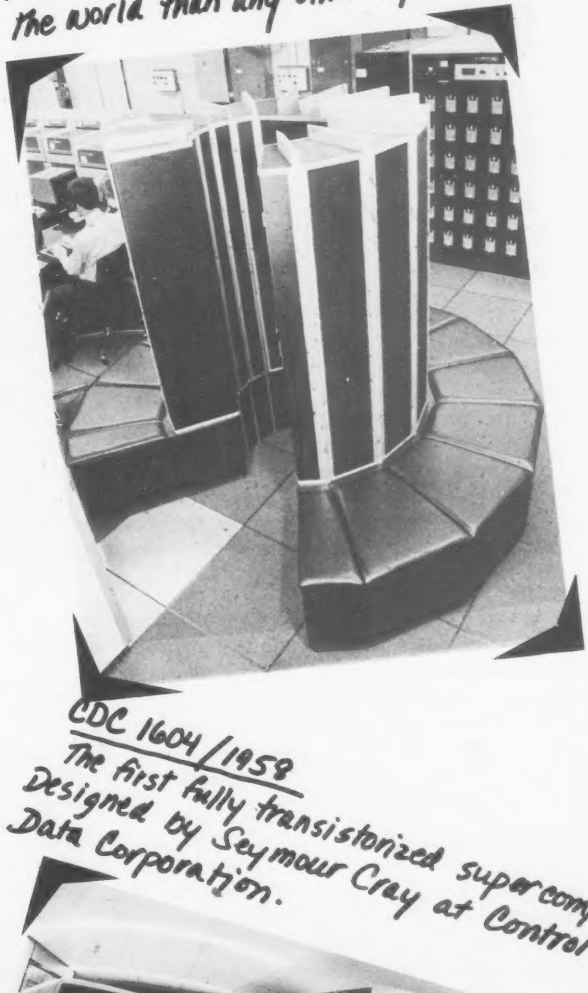
Computers

CDC CYBER 205/1980

This machine is the latest from the first family of supercomputers. It performs 50 million instructions per second.

CRAY 1/1975

The first and fastest designer computer. You can choose colors to match your decor. There are more Crays installed around the world than any other supercomputer.



ILLIAC IV/1967

Burroughs built this computer for global weather forecasting for the University of Illinois.

CDC 1604/1958

The first fully transistorized supercomputers. Designed by Seymour Cray at Control Data Corporation.

E X T R A

COURTESY OF METROPOLITAN MUSEUM OF ART. "THE FORTUNETELLER" By Georges de laTour

New Computer Architectures

The art of fortune-telling has been around as long as people have wished to know what their future holds in store. Fortuna was an ancient Roman deity who knew the will of the gods and ruled over chance and good fortune. Likewise, Tyche was the Greek goddess of fate. More than three thousand years ago, the sage Lao-tzu used the *I Ching,* or Book of Changes, to divine the future. The Cult of Thoth in ancient Egypt is believed to be the first to use the Tarot cards for divination; the gypsies told people's fortunes with the Tarot throughout medieval Europe.

Herman Lukoff, who was present during the Moore School experiments with Univac, writes of similar attempts to foretell the future of computers in his book *From Dits to Bits:* "There has been an early forecast that five systems would be sold. I had even heard some wild speculation that this country could support eight or 10 systems . . . the future was certainly unclear."

Today, the greatest challenge seems to be attempting to define user needs in computing. Just as form follows function, computers have been enlisted into the service of mankind to fulfill needs, and these needs have been changing.

By Jack B. Rochester

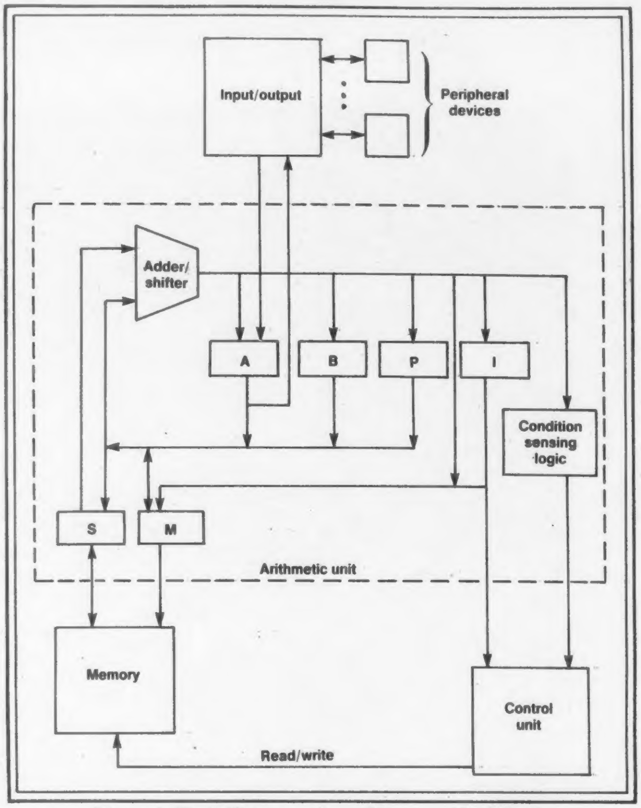


Figure 1. Block Diagram of von Neumann Architecture

Thus, in turn, computers have been changing as well. We've seen an evolution from a time when only two people — the operator and the repairman — knew the status of the computer, to an on-line environment where everyone is immediately aware if the computer goes down.

Robert Alloway and researchers at MIT's Center for Information Systems Research have just concluded a survey at 19 industrial companies, encompassing 1,058 managers, to determine user needs. Their findings conclude that only 19% of the systems in the installed base are appropriate for managers' needs for analysis-oriented systems, and only 42% of the installed systems are relevant and appropriate for supervisory, support, clerical and other users' needs. The demand for appropriate systems in all transaction processing systems exceeds supply by more than 200%. Clearly, we need more computers — or more something.

How We Got Here

John von Neumann's stored program concept, which solely defined computer architectures for more than 30 years, is now legend. From Eniac to the IBM 360 and 370 series, one CPU did the processing. Prior to the 360, one computer ran one peripheral, such as the tape drive. If you wanted to use a disk drive, you had to buy another computer. The 360 separated the I/O and processor channels and established a multiprogram environment, thus creating upward compatibility. It was a great step forward.

However, the 360 was also the first machine for not only commercial data processing applications, but for scientific applications as well. What that meant was that no matter how many jobs, each was still run in a one-at-a-time environment (see Figure 1).

As CPUs grew more powerful, more and more users got in line to use the computer, and in the late 1960s, the concept of time-sharing emerged. One of the first was Hewlett-Packard Co.'s HP 2000. The underlying premise was still founded on number-crunching, a holdover from when military applications and batch processing prevailed. The operating system permitted multiple users, as long as it was still basically one big job. Or, as George McQuilken, president of Spartacus Computers, put it, "Time-sharing is one computer using 200 people." Nevertheless, time-sharing allowed many to share the CPU and expensive memory as well.

Agents of Change

During this period, IBM realized the 360 architecture was functionally deficient in several areas, including interactive applications and data base functions, and began working on a new line of computers designated the Future Systems project. The System/38, introduced in 1978, marked a radical architectural departure from existing IBM machines in several ways, the most notable being that the machine and its operating system made a clear distinction between data and storage.

International Data Corp. stated in a research memorandum in May 1981 that "Substantial success with the System/38 will probably increase IBM's willingness to introduce more radical architectural concepts for large systems sooner." Even if it did not do so, IBM seemingly had sent a clear message to the industry at large: We are not afraid to innovate.

The time for innovation was ripe. By this time, users were crying out for more power and more memory. While someone might be doing data entry most of the day, that person was also preparing reports, doing word processing or a variety of other jobs. DP managers were having problems balancing the load; the cost vs. risk payback between capacity planning and underutilization was giving everyone headaches. Do you add another mainframe while maintaining the same software and operating system, or do you try a distributed configuration — throw a couple of minis into the most severely depressed areas and see what happens? As James Cordata says in his book, *Managing DP Hardware*, "With hardware costs now running about one-third of a data processing budget for most organizations, the answer to better management of equipment can mean expenditures of savings of hundreds of thousands of dollars annually, even in small and medium-size companies." For many, it was a roller coaster ride they couldn't get off.

The Ongoing Problem

Reliability has plagued DP from the beginning and only aggravated the problem of providing adequate computing power. Traditionally, there has been only one solution: Buy a second computer. The problem reached epidemic proportions when DP shops had to buy, say, an IBM 4341 for backup.

Networks and distributed data processing suffered the same deficiency. Bill Foster, president of Stratus Computer, Inc., likened the situation to an automobile's rotocap: No matter how many wires are connected, it's still one engine.

In 1976, Tandem Computers, Inc. was founded on the premise that reliability was of paramount concern and no one wanted to sacrifice performance to get it. Linking two redundant computers in parallel through a software interface turned out to be a good idea. As David Mackie, vice-president of Tandem, said, "You might as well make it nonstop, because it's free."

Stratus Computer's Foster agreed that fault-tolerant computing is free, but added that the shift toward on-line systems makes it imperative. "We're very dependent on computers today. It's a disaster when they break. If the computer stops working, everybody's affected."

Stratus, instead of having two redundant systems, uses one to 32 processing modules, each with two CPUs. If one CPU — a Motorola, Inc. 68000 — goes down, it's replaced by the other. Unlike the Tandem system, it is totally hardware redundant. Both appear as a virtual system to the user.

New Cue on Queues

Synapse Computer Corp., a new startup, takes a different approach.

(Continued on Page 36)

New Architecture Spotlight

New architectures offer both hope and chaos for the DP manager.

Briefcase Computer

Why should Epson, a dot-matrix printer company, introduce a computer with a set of features that defies categorization in any existing niche of the microcomputer market?

First, look at the Epson HX-20. It's small, (roughly 8½ in. by 11 in. and just under 4 lbs.), but it couldn't be considered a member of the existing "hand-held" family. It's powerful (16K-byte random-access memory expandable to 32K bytes, and 32K-byte read-only memory expandable to 64K bytes), but it couldn't fit in the desktop business computer family. It has a built-in printer, LCD display and optional microcassette drive, but given all these features, just what can you do with it?

It is this smallness that gives us the best clue to the HX-20's applications. Despite its economical size, it has a full-size Ascii keyboard. This, of course, is important for programmers who require rapid and easy data entry. Its vocabulary is a full, extended version of Microsoft, Inc.'s Basic with commands similar to IBM's Personal Computer Basic. The processor is a dual 6301 Hitachi Ltd. Cmos system designed for extremely low power consumption.

Aside from the obvious attraction for gadgeteers and pioneer "bit twiddlers," it is the person on the go who will have the greatest use for the HX. The briefcase-size unit can be used on board an airplane. With its full- and half-duplex selectable acoustic coupler, the CX-20, the traveling salesperson can now have instant and easy access to the company's main computer from any phone.

One of the most interesting and unique features of the HX-20 is its port for a bar code reader. This could be very useful for inventory control, as remote reading in supermarkets. At this point, the most perplexing questions seem to be "what" and "when." In order for many users to realize the full potential of this machine, they are going to need some or all of the peripherals. Certainly, another concern for the potential HX buyer is software. As of yet, there is no official word about available read-only memory programs. Since the HX does not have CP/M capability, there is no preexisting software library from which to draw.

As a writer, my personal preference would be to add word processing that would make the HX an unbeatable note-taking and composing device. At $795, the HX-20 should, at some point, enjoy wide application for both the personal and business user. Its unique set of features does not immediately place it in any specific corner of the market, yet serious computer users will see its portent for the future of desktop portable computers.

By Randall C. Cade

Distributed Processing

Like other computer architectures, Apollo Computer, Inc.'s domain processing systems utilize virtual memory techniques to give programmers and users very high addressability for large programs. Also like other systems, Apollo provides high-speed network communications. But unlike other systems, the Apollo architecture combines virtual memory operation with communications to create a level of distributed processing transparency that goes beyond contemporary architectures.

Rather than implement virtual memory on a machine-by-machine basis, then communicate via standard protocols, Apollo's designers chose to create networkwide virtual memory, then to map that into the individual machines' own virtual — or real — memory as needed. There is no need for protocols, file transfers or message-switching systems.

Domain processing permits networkwide application transparency. At a local node, for example, a user can execute a program that exists on a remote node, reading input from a third node and printing out results on yet another machine — all without knowing or caring where these transactions are taking place. Also, users can display multiple, concurrent windows of separate functioning processes on their terminal screens, overlapping and moving them about like papers on a desk.

Application programs also reside at the network-global level rather than at the node level, with all programs and files referenced across the entire network via the name space-address' multilevel directory structure.

This gives the user a truly and totally distributed view of programs, files and shared resources and makes it possible to process large applications from diskless nodes (as long as a disk does reside somewhere on the network). To do this, the diskless machine simply takes its 1,024-bit virtual memory "pages" from a remotely located disk drive as if the disk were attached locally. As a result, hardware costs can be optimized across the network.

These and other features are a result of combining high-performance hardware — 32-bit processors, Winchester disks and bit-mapped graphics — with software powerful enough to serve extremely demanding applications.

Five years ago it wouldn't have been possible to combine 32-bit supermini processing power with high-resolution graphics and networkwide virtual memory operation. Today, thanks to mature, economical hardware and highly sophisticated virtual memory software, it is now within reach of numerous engineering applications.

By David L. Nelson

Transaction Processing

Transaction systems generally track business growth. But what happens when transaction throughput saturates the classic computer-memory architecture and it's time to upgrade? Addition of more computers could increase transaction throughput, but only if the total data base need not be available to all processors. Otherwise, the problem must be solved many times, or at least moved. Even if the bus connecting multiple loosely coupled processors is infinitely fast, the loose coupling alternative increases the overall transaction processing time and adds substantially to the complexity of the original system design. This is why the typical solution to transaction resource saturation is to bring in a bigger engine, rather than getting more of them. The Synapse Computer Corp. tightly coupled architecture allows for graceful growth of a single computer system over a wide range of performance.

The operating system automatically allocates and tunes the available processor resources to meet the requirements of the specific application mix. Modules may be inserted or deleted under power, without taking the application program off-line. Hence, the smallest system can become the largest system.

A specific processor mix for the maximum configuration is not meant to suggest configuration rules. A system with large, active data bases will require different resources than a system with large numbers of high-speed terminals. And those systems will differ from highly computational environments. The advantage of the Synapse N+1 is that it doesn't matter what processor mix is required, since modification is partially a process of system self-tuning and partially a process of addition of resources without taking the application off-line.

Synapse does not require duplication of every component to achieve high availability, nor does high availability require performance sacrifices. In a healthy system, additional redundant resources contribute to additional throughput. In fact, even if more than one of the processor types simultaneously fail, the system still operates with a graceful degradation of performance.

Because the Synapse N+1 is transaction-oriented, any resource can be lost without significant system impact. The malfunctioning unit can be taken off-line and control resumed by alternate system resources. From the terminal user's point of view, the recovery process requires at most reentry of data to the screens displayed since the most recent checkpoint. However, all of this is transparent to the application program.

By Kenneth I. Cohen

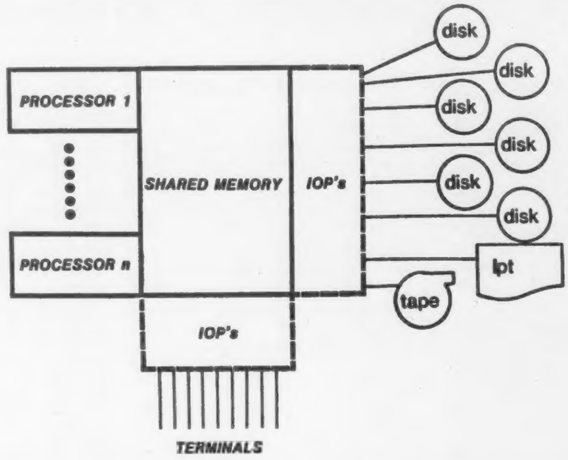


Figure 2. The Synapse N+1 System: Basic Architecture

(Continued from Page 34)

Previous architectures employed the single-server, single-queue principle, much like the lines at a grocery store checkout. Synapse embodies a multiple-server, single-queue approach, like the roped aisle in a bank lobby or at an airline counter. Its architecture uses tightly coupled multiprocessors tied to a common memory. Each processor functions autonomously and yet shares resources, in much the same way users at terminals share a common data base to satisfy many needs.

Synapse goes one step beyond machine dependence. The processor chip the company currently uses is a Motorola 68000, but it can be replaced by another, better chip, should one become available. If all the processors are up, system performance is enhanced. Any processor can serve any user's needs, and if one fails, another takes its place without the user knowing (see Figure 2).

The Other Road

In today's multiuser, multiapplications environment, the stand-alone workstation offers another avenue of relief. The concept of the information utility involves each user having his own CPU while sharing a data pool. Convergent Technologies, Inc. introduced the Integrated Work Station in 1979, the first 16-bit standalone machine with a modular design that permitted plenty of add-on memory and functions.

Although not at odds with fault-tolerant machines, the workstation architecture represents a different approach to meeting user needs. Most workstations provide data processing, word processing and high-level languages support, with some memory storage on-board and a great deal more available at other nodes on the high-speed data link. The Convergent machine interfaces with other computers and data bases (as do some others), which has allowed Convergent to OEM its product to firms such as Burroughs Corp., Savin Compucorp, Inc. and NCR Corp.

Apollo Computers, Inc. offers a similar configuration in a 32-bit machine that performs what Apollo calls domain processing. While it is inherently distributed, it is not nonstop; yet failure on a node does not permeate the system. "The basis for the architecture is in distributed machines, but it is inherently more powerful and economical," said Dave Nelson, vice-president of systems development at Apollo.

"Both workstation and nonstop technologies are growing explosively," McQuilken stated, "but are contradictory trends. It's all very innovative." The innovation, by and large, has resulted from microprocessor technology pioneered by Intel Corp. with the 4004 in 1971 and the subsequent 8008 series throughout the '70s. As the economies of scale increased, prices dropped. "Costs for a Motorola 68000 have dropped 80% in the past 18 months," Foster said. "We can now buy the power of an IBM 4341 for under $50." Likewise, memory chips have decreased in price; a 64K random-access memory chip has fallen from $25 to $6.

The Intel iAPX 432 promises to revolutionize the industry again. Its 32-bit "micromainframe" architecture incorporates a silicon operating system that enhances throughput, and was designed to bring new programs on-line without interrupting work being done by the user. It also satisfies the continuing problem of capacity planning vs. underutilization. It can be initially configured for a single user, then expanded as needs dictate. "It has the potential of leapfrogging technology due to its aim at the heart of a few current industry weak points," said Jerry Horn, president of Microprocessor Systems, Inc. (MSI). MSI is developing a computer system configured on the 432 that will be available next year for $60,000 and will compete with IBM mainframes costing four times as much.

You Can Take It With You

Meanwhile, a variety of briefcase-size computers are being introduced, among them HP's HP-75, Grid Systems Corp.'s Compass and Epson America, Inc.'s HX-20. These machines, ranging in price from $800 to $8,000, promise to ease key executives into the computer age by offering the features and power of desktop computers and minis while making it fun to process data. The old axiom, "The only difference between men and boys is the price of their toys," seems to be at work here. One company head — who used to spend most of his time reading mystery novels while traveling — now writes letters on his portable computer and transmits them to the home-office word processing system from a telephone booth.

The proliferation of new architectures offers both hope and chaos for the DP manager. On the one hand, many of the nagging problems that seemed like they would never go away are being addressed and corrected. On the other hand, we still need to make some semblance of a coherent system out of all these various machines. And it's important to understand these various new architectures and how they fit into the overall organizational planning. Harold Lorin, a consultant at IBM's Systems Research Institute, said, "Fundamental knowledge of computers is a specialty. We need a new generation of architectural designers over the next two decades."

One thing seems certain: There are opportunities, perhaps for the first time, to perform a wide variety of data processing tasks more cost-effectively. More than 10 years ago, Alvin Toffler said in his book *Future Shock*, "We will soon see the day when diversity costs no more than conformity." Perhaps that day is now upon us.

References

Cordata, James W. Managing DP Hardware: Capacity Planning, Cost Justification, Availability and Energy Management. *Englewood Cliffs, N.J.: Prentice-Hall, 1983.*

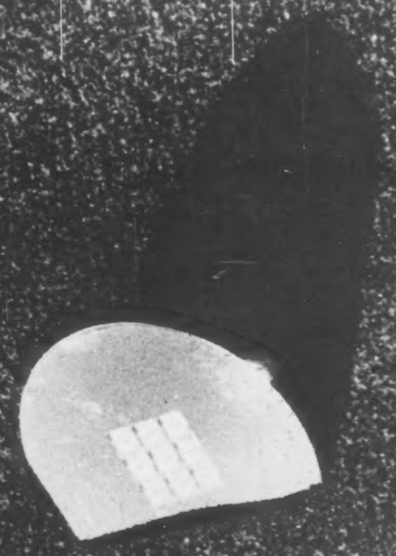
Lorin, Harold. Introduction to Computer Architecture and Organization. *New York: John Wiley & Sons, 1982.*

Myers, Glenford. Advances in Computer Architecture, Second Ed. *New York: John Wiley & Sons, 1982.*

Siewiorek, Daniel P., Bell, C. Gordon and Newell, Allen. Computer Structures: Principles and Examples. *New York: McGraw-Hill, 1982.*

Stone, Harold S., Ed. Introduction to Computer Architecture, Second Ed. *Palo Alto, Calif.: Science Research Assoc., 1980.*

EXTRA



CHIP TECHNOLOGY

The race is on to catch the speed of light. Faster processors are in demand, and some researchers are skeptical that production techniques using silicon-based chips will not hold up under the intense heat and potential electrical interference involved with making smaller, faster chips.

Scientists and chip manufacturers agree silicon will remain a strong force in the electronics industry for some time to come. But many scientists feel newer technologies may work more effectively. Chip manufacturers, as well as computer makers, point to the relatively low cost of silicon-based devices and contend that none of the manufacturing techniques currently under investigation can equal the economy offered by silicon.

One of the most talked about alternatives to silicon is cryogenics, a process by which circuits lose much of their resistance when cooled to near absolute zero. The cooling process is accomplished by immersing the circuits in a very cold liquid. Josephson Junctions, a concept developed in 1962 by inventor Brian Josephson, uses liquid helium as a coolant. Seymour Cray, father of the Cray 1 supercomputer, recently announced plans to build the Cray 2, using a liquid fluorocarbon bath as a coolant.

At this point, commercial production of a cryogenic processor appears to be at best five years away. Some vendors, such as IBM, say a Josephson Junction processor may be as many as 14 years away.

Bell Laboratories recently constructed a prototype Josephson processor. However, the unit executes instruc-

By Tom Henkel

tions at about the same speed as mainframe processors currently on the market. While the actual processor has a switching speed of about 2 nsec, it takes a total of 30 nsec to get information from the liquid helium bath to the conventional silicon-based circuitry that makes up the rest of the processor.

Photon Chip

Researchers at the University of Illinois are working on a photon chip, which uses light instead of electrical impulses to move information. Called optoelectronics, the chip can theoretically process both electricity and light. If perfected, the technology could mean smaller chips that are very fast and give off very little heat. However, the photon chip is still in the research stages. A prototype chip has yet to be developed, and Prof. Nick Holonyak Jr., leader of the research project, said it may be 20 years before an actual chip is fabricated.

Working on the same basic concept as the University of Illinois researchers, Dr. Henry Smith, a researcher at MIT's Lincoln Laboratory has developed a process called graphoepitaxy, which allows silicon to be developed under artificial conditions. The process, while still experimental, could lead to the development of a chip where circuits can be stacked on top of each other. This three-dimensional chip means more circuits could be built in a relatively small area. However, heat dissipation and connecting circuits still pose a problem to that technology.

Biotechnology is another possible alternative to silicon. Some scientists believe molecules can be custom-grown to act as tiny circuits. If perfected, the technology may yield circuits about 500 times smaller than current silicon devices.

The theory, now being investigated at the University of Mississippi and elsewhere, involves electron-rich molecules passing electrons to other molecules.

Other Alternatives

More conventional silicon alternatives also abound. Gallium arsenide has been touted as a faster, more efficient substratum on which to build circuits. However, current gallium arsenide production techniques are not as successful as those used for silicon. Denis McGrievy, manager of the semiconductor department at Gnostic Concepts, Inc., said gallium arsenide chips can cost 100 times more than silicon chips. On the other hand, recent advances in gallium arsenide production techniques may dramatically decrease the cost of the technology.

Prof. James J. Coleman, an electrical engineering professor at the University of Illinois, uses gallium arsenide as part of the optoelectronic chip. He believes gallium arsenide is becoming more reliable, and hence may reduce the cost of gallium arsenide chips.

Silicon Lives

Not all research is aimed at replacing silicon. Some scientists hope to improve existing technology to a point where circuits are considerably faster. IBM, as well as others, has found that lasers can be used to etch smaller, more clearly defined masks on chips.

Masks are tiny stencils that control the flow of electricity through chips. By reducing their size, chips conceivably can be designed on a smaller silicon chip.

Other researchers contend the next major advancement will be the ability to mix several types of silicon devices on a single chip. The advantage of this concept is that applications using high-heat, high-speed devices could be reduced. However, some analysts maintain that the process would make silicon fabrication much more complex, thus making the chips too expensive.

Even if some of the new semiconductor technologies can be parlayed into proven manufacturing techniques, they may not have a dramatic impact on a large number of users. Faster processors appear most attractive to scientific users.

The University of Illinois' Coleman pointed out that users dealing with a relatively small set of data — such as encode/decode applications carried out in defense applications — can benefit by a superfast processor, whereas commercial users have a harder time. The average commercial user tends to use a lot of data that must be randomly selected from disk storage. Since peripherals are electromechanical devices, they cannot be made to work as fast as the processors. Consequently, armed even with the fastest processor, most commercial users wouldn't see a significant peformance improvement, Coleman said.

Techniques to improve peripherals also exist, but they do not promise the significant performance improvements offered by some semiconductor technologies.

Laser disks, for example, may make disk storage faster and more reliable, but the best way to solve the storage problem is to switch to internally stored data, according to Coleman. Random-access memories, such as 256K- byte chips being tested by IBM, General Electric Co. and others, may provide commercial users with enough locally addressable memory to take advantage of faster processors.

Coleman noted that other peripherals, such as printers, tend to be even slower than disks; however, those devices tend not to be direct inhibitors to processing.

OEM Acceptance

Another constraint to new semiconductor designs is gaining acceptance from the OEM community. Most systems makers buy chips from a variety of semiconductor houses. Some technologies, like random-access memories, are fairly standard. However, vendors also commission semiconductor houses to do custom work as well.

When a new technology is developed, it must be tested before it can be incorporated in a computer system. William R. Thurston, president and chief executive officer of Genrad, Inc., noted that the specifications for a chip set that used to take up a couple of pages now takes up several booklets. And even with that information, many systems designers must order even more tests to make sure the new devices will not pose compatibility problems once installed in a system.

Somewhere between the laboratory and the production line lies the technology of the future. There's no guarantee that new technologies now being researched can be mass-produced. Even if a faster, cooler and more economical chip technology is developed, it is only part of the battle. Peripheral technology must be vastly improved to allow commercial users, the mainstay of the computer industry, to make the best use of faster processors.

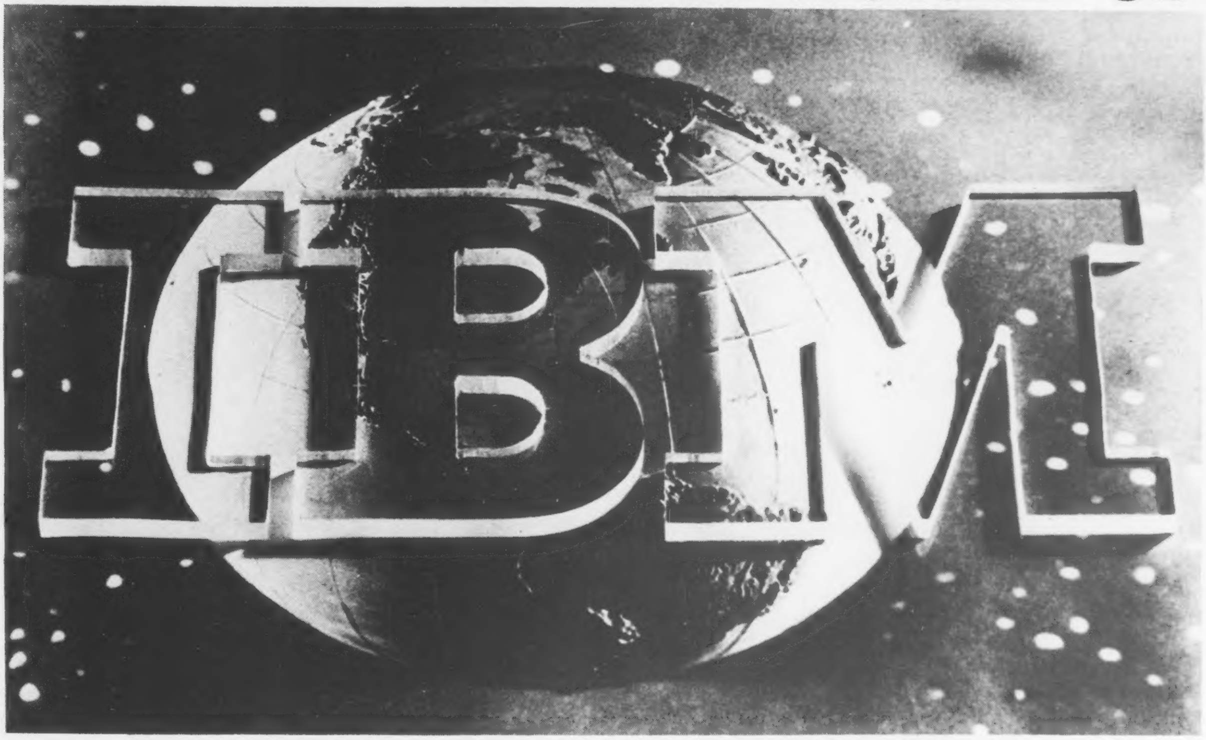
Getting computer manufacturers to accept new technologies is another problem. Unlike the early days of computing, top executives of computer firms are businessmen first, technologists second.

Switching to a new technology or architecture is not a simple decision. Reliability, serviceability and compatibility with the existing product line are key issues with which top executives must wrestle. In the increasingly competitive computer industry, radical changes in a firm's product line often are met with some skepticism.

The technology of tomorrow may take 20 years to arrive. In the computer business, miracles don't just happen. But we still need to believe in them. ◆

Henkel is a writer/analyst at Computerworld *who specializes in hardware and chip technologies.*

LOOKING AT THE WORLD OF



PHOTOGRAPHY BY GARROW THROOP

The story is familiar to most of those who are knowledgeable about the data processing industry. The highly prized executive of the nation's premier business machine company is about to depart its employ. The corporation itself is a model of efficiency and rightfully enjoys a reputation for intense and successful marketing. Its salesmen seem to have been stamped from the same mold: They are driven to perfection, pressed to fill quotas and tend to favor dark suits when calling on customers, who know the company's machines are reliable and service excellent, but the technology behind them may not be the latest in the field. Finally, this corporation has a motto, emblazed on the walls of every office: **THINK**.

The executive has quarreled with top management, which is the reason for his departure. He takes one last look around and vows to create a corporation greater even than the one he is leaving.

No, it isn't Gene Amdahl exiting from IBM a dozen years ago, prepared to create the company bearing his name with financial backing from Fujitsu Ltd., Nixdorf Computer Corp. and Heizer. Rather, that executive was Tom Watson Sr., taking his leave from NCR Corp. in 1914 to become general manager and, eventually, chief executive officer (CEO) of the fledgling Computer-Tabulating-Recording operation that 10 years later he renamed International Business Machines, Inc. Watson took more with him from NCR than a determination to show up his old bosses. In large measure, he transplanted to his new home the old ways and the corporate elan — right down to the motto and company songs.

Watson — who belongs on anyone's list of most important American businessmen in the 20th century — provided

By Robert Sobel

IBM with more than innovative leadership, drive and an uncanny knack of pleasing customers. He fastened upon the corporation an image that it retains to this day in the popular press — a firm with conceded brilliance in sales, but second rate in most other areas. Just prior to his death, Watson was supposed to have said that if he had it all to do over again, he would have preferred to serve as sales manager rather than CEO at IBM.

Statements such as this, combined with the image Watson consciously created for his corporation, contributed to this reputation. Moreover, from Watson on down, each of IBM's CEOs came from a background in sales. But this is only part of the story, especially today. John Opel, who will lead the corporation until 1985, also served in finance and management and, in the early 1960s, even worked briefly in public relations, which gives him the kind of background needed to meet both self-imposed and externally generated challenges.

More to the point, large numbers of salesmen at other information processing companies are every bit as good as IBM's — in part, because so many of them were hired away from Big Blue, but also because these firms have imitated IBM's marketing techniques. What IBM does have — a legacy from the Watson Sr. era — is the mystique of near infallibility, renowned in myth and fact. For example, on one occasion, ITT's Harold Geneen was shown a microcircuit assembly manufactured by one of his European subsidiaries. After learning that it sold for $40, Geneen snorted that the price would have been $80 if the initials on it were IBM instead of ITT, and there is something to this.

Competing From the Lab

But if IBM's salesmen are perhaps overrated, the corporation's research and development is underestimated. This situation troubles the Armonk, N.Y., headquarters, which will promptly produce lists of technological breakthroughs when challenged on this score. Recently, Opel observed that IBM has expended close to $8 billion over the past six years on research and development. Not only is this more than the amount spent by the rest of the domestic industry combined, but it is a greater sum than for all of the overseas competitors. Thus, IBMers have mixed feelings regarding the allegation that Hitachi Ltd. and Mitsubishi agents have attempted to purchase their company's technological know-how. On the one hand, there is understandable outrage, but on the other, a sense of pride. "They didn't go to Control Data or Digital Equipment, they came to us," was the reaction of one proud IBM technician.

Several months ago, prior to the disclosure of "Nipponscam," a Japanese businessman expressed surprise that so many Americans were attempting to uncover the secrets of his country's remarkable economic performance. "After the World War, we tried to find out why you were so strong, and it came down to the performances of key American corporations. So we studied their techniques." The most important of these, he said, were 3M Co., Proctor & Gamble Corp. and — of course — IBM.

Marketing Strategies

Like IBM, the Japanese tend to wait until the market for a product or service is well established and conducive to mass production and distribution techniques; they then enter in force, offering more performance for lower costs. This was how the Japanese captured so many markets for consumer electronics.

The experience resembles that of IBM in several computer lines. CDC pioneered in large mainframes, of course, with IBM arriving late. The same happened on the other end of the spectrum with DEC, and now IBM is challenging Commodore Business Machines, Inc., Tandy Corp. and Apple Computer, Inc. in microcomputers and Wang Laboratories, Inc. in word processors. Given the corporation's expertise and research accomplishments, IBM might have been first in all these areas, but that simply is not the way the corporation's culture manifests itself. IBM had done pioneering research in chips, for example, producing more 64K-bit random-access memory chips than the rest of the world combined, but all are used internally. Had Cary and Opel elected to do so, they might have deployed IBM's assets in this direction and thereby dominated the market. Instead, the corporation held back,

permitting the Japanese and others to establish strong beachheads and, in fact, today IBM purchases 64K-bit chips from vendors. In this instance at least, the Japanese domination in manufacture might have been prevented had IBM the will and incentive to do so. The same pattern may develop in the field of 288K-bit chips and other products that emerge from IBM's research.

Slugging It Out in Court

In the past, much might have been attributed to fears of antitrust prosecution, but the corporation's stunning victory in the recent marathon case changed all this. In addition, a growing awareness of the successful relationships between Japanese business and government perhaps will lead to something similar here. Most likely, IBM will be spared prosecution for the rest of this century; freed from such worries, it can be counted upon to be an even more aggressive competitor, both in strategy and in the field.

Had this business and regulatory climate existed a decade or so ago, IBM might have swamped the field, but the explosion in information processing and communications would appear to make that goal impossible for any one corporation — even an entity with revenues of $30 billion. Yet Opel has set out to do just that, which has required a tremendous effort, with more to come in the future. IBM will have invested over $10 billion in new plant and equipment from the beginning of 1976 to the end of this year. Net investment in plant, rental equipment and other properties has more than doubled in this period, during which the long-term debt will have risen from $256 million to well in excess of $3 billion. Yet, in the same span, the number of employees has remained virtually the same — around one third of a million. In 1976, revenues and earnings came to $16.3 billion and $2.4 billion, respectively; for 1981, those figures were $29.1 billion and $3.3 billion.

The corporation at the same time is leaner and larger, with perhaps the most modern physical plant of any major firm in the industries in which it operates.

While IBM is far less secretive than it was during earlier periods, it still likes to play its cards close to the vest. But when a corporation of this size makes alterations in its structure while entering into major capital and human investments, its basic strategy is not that difficult to perceive. As one writer observed, the tracks left by a mastodon often give the astute observer a good idea of its direction.

If IBM's refusal to enter into several new areas before rivals had secured their positions marked its most serious product blunders over the past two decades, its worst financial miscalculation came in 1977. At that time, the corporation had cash items and equivalents of close to $6 billion; it spent $1 billion of this cache to repurchase its own stock. Two years later, IBM was obliged to go to the financial markets to float a like amount of debt, and it has been there ever since.

These dates are significant. Between them, IBM decided to be the only corporation in the world with strong commitments to the entire spectrum of information processing, not only guarding its own domains, but challenging on their own turfs the likes of Xerox Corp., DEC, CDC and, in time, Commodore, Cincinnati Milicron, Inc. and even AT&T. To do this, IBM would require huge amounts of capital — which is why that stock repurchase seems so misbegotten today.

While IBM slugs it out on its own in most information processing areas, it will enter into new partnerships in other fields, especially when by so doing it can buy talent, time and capital. The most obvious partnerships would be in robotics and other areas related to direct industrial manufacture, in which IBM hasn't much expertise.

Strategies for Change

As is well known and already indicated, IBM has for years been able to reap huge dividends from its reputation for efficiency and service, but that time is rapidly passing. This is not because the company's products and services are somehow less attractive, but rather because the sophistication of users and the ingenuity of others in the industry are growing. That cost advantage Geneen once complained about is diminishing. In the future, IBM will have to be even more cost-effective than it has been in the past.

A beginning toward this revised strategy might have been Perceived in 1979. At that time, the corporation an-

Looking At the World Of IBM

nounced its pricing schedule for the 4300s, which, as it turned out, was far lower than anyone had expected. Rather, IBM was counting on its recent adoption of mass-manufacturing techniques to computers to permit not only this reduction but others to transpire. Others had tried it before, but now IBM was taking the plunge into the sale and lease of what amounted to off-the-shelf computers and peripherals or, as one commentator called it, "unbundling with a vengeance." The customer would be weaned from hand-holding and extensive servicing and, in return, would enjoy substantial price benefits.

This new approach will be expanded in the future. Efficiencies in assembly-line manufacture combined with unbundling will enable IBM to undercut most of its rivals in price/performance. As an outgrowth, look for a lower ratio of sales and service personnel to management and manufacture at Watson's old company. The day of the salesman at IBM has not ended, but the old luster may fade; young people entering IBM in hopes of managerial careers may find the path upwards just as fast from the factory floor as from the salesman's sedan.

Indeed, the vaunted IBM sales force, which recently has been united in a further attempt at realizing efficiencies, cost-cutting and streamlining, may undergo still further wide-ranging alterations as the corporation enters new markets previously unexploited or unexplored. The advent of the Personal Computer and the Displaywriter has led IBM into selling to small businesses and even individuals — practices at which the corporation is still awkward. One can see the signs in many places. Who would have thought in 1970, that IBM would have storefront offices where machines and services would be demonstrated and offered to anyone coming in off the street? Or that IBM would use a Charlie Chaplin look-alike in ads that are positively playful and downright undignified? Perhaps the corporation can make a go of it here, on the basis of sales and products combined with reputation. But this won't do in a huge and as yet unexplored market, for which IBM apparently has no strategy in place.

Masterminding Technology

Along with most others in the industry, IBM has assumed the mastery of data will be the key to the next industrial revolution — thus the stress on information processing and distribution. This does not mean the companies that make out best will be those possessing the superior technology or offering competitive prices. Rather, the winners may be those with the most accessible products and services, capable of capturing future users at the right time.

For example, it may turn out that the key product of the mid-1980s will be a simplified word processor purchased by students, rather than the minicomputer and modem in the hands of an office worker. The leap from an Atari game to a Wangwriter into data processing may be the way of the future. If so, it will be much easier for these companies to expand upward than for the IBMs and DECs of this world to feel their way into the consumer markets.

Each manufacturer claims its offerings are "friendly" and, to a degree, this is so. Up to now, however, no manufacturer has mastered the knack of selling to individuals who lack a technical background and as yet feel no need for DP capabilities, but who could be shown the way via word processing. If the path to future sales is from word to data processing — as many now suspect it to be — IBM is one of many that can't find the way.

Just as IBM conceded the student market for electric typewriters to Smith-Corona/Marchant without a struggle, so it may do the same for word processors utilized by non-office personnel. Creating a strategy to win this burgeoning market — which can be larger and more important than virtually any other — is a challenge IBM has yet to acknowledge.

High Noon

This may be a far more important matter than the one that receives so much industry and media attention, namely, the anticipated "showdown" between IBM and AT&T, now that both giants have been freed from antitrust problems. True, IBM is entering data communications, while AT&T can be counted upon to nibble away at information processing through a newly born American Bell, Inc. But neither company is about to mount a concerted assault against the central business of the other.

AT&T's Advanced Information Systems Net 1000 will not clash head-on with IBM's Information Network, and Bell has no intention of entering the mainframe business. Each is well aware of the other's strengths and knows the potential rewards in such a contest are not worth the obvious risks. AT&T will continue to be IBM's largest nongovernmental customer, while IBM confines its data transmission business to those already in place.

IBM's across-the-board product and services strategy was initiated and brought to fruition by Cary. This was his most important bequest to Opel, who will have three more years to implement it prior to stepping down in mid-decade. By then, IBM should have revenues of approximately $50 billion, while earnings (always more difficult to predict) could be well in excess of $5 billion.

Such recently introduced products as the 3083, 3380, Personal Computer and Datamaster will be close to the end of their cycles and be replaced by newer, faster and lower cost products. IBM will be the most important producer of 288K-bit chips, but will still have to purchase additional units from vendors. The new Personal Computer will go for around $1,000 to $2,000, even allowing for inflation, while there will be word processors in the market selling at $1,500, including a letter-quality printer.

In all probability, IBM will be getting a slightly larger share of its sales and profits from services than it does today. Competition will be keener, perhaps, because there will transpire within the industry a mergermania that, while thinning ranks, will strengthen those that survive.

The Japanese will have made their initial push and, while gaining market share, won't threaten the leaders in any central product area. But talk of an impending Japanese challenge will continue, especially in the pages of popular and business magazines. There will be an IBM-AT&T contest of sorts, as Satellite Business Systems decides to offer long-distance telephone service, but this field will be so crowded that, in the end, the Federal Communications Commission may be obliged to intervene, limiting competition severely.

By then, too, IBM's reputation in management, finance and technology will be greater than it is today, and we'll hear fewer stories and jokes regarding the vaunted IBM salesmanship. A greater percentage of revenues will be poured into R&D and less into new plants.

Just how fast will this growth be? One could do worse than to watch Watson's old employer, NCR, for the answer. Most years, IBM has added roughly the equivalent of an NCR to its revenues. This, too, should continue into the foreseeable future. ◆

Sobel is a professor of business history at Hofstra University. He has written nearly a dozen books, including IBM: Colossus in Transition (1981). *His next work,* ITT: The Management of Opportunity, *will be published by Times Mirror Books this month.* ‡

E X T R A

INTELLIGENT LEASING

Why lease? It is surprising that many managers do not ask themselves or others why they should lease computer equipment. If you don't know whether to lease and don't know what leasing can do for your company, you should be asking this question. Some of the answers you might turn up are the following:

• To save money. This is the single most important answer to the question. In some cases, the earnings and tax situation of a company that wants to acquire a computer will not permit it to take advantage of some of the tax benefits of ownership. Even if a company can make good use of the tax benefits, it can still save through a third-party lessor that is

Henry S. Beers Jr.

ILLUSTRATION BY RICH TENNANT

able to make better use of the benefits and pass the savings along in the rents.

• To conserve capital. By leasing a computer, a company can conserve capital for investment in the projects with highest returns. This is a common advantage to be gained from tapping the leasing market for part of a company's total funding.

• For budget considerations. One of the more difficult aspects of financial planning is coping with large bulges in expenditures, such as outright cash purchase of equipment, that are not matched by large bulges in revenues flowing into the company. Leasing can be used to replace such large cash flows with streams of uniform and individually lower expenses and trade-offs between capital investment and expense.

• In tax planning. Leases can also be used in tax planning, which can be quite important to a company's financial fortunes. Outright purchase brings the early tax benefits of accelerated depreciation and investment tax credit. However, if there isn't enough profit against which to charge the depreciation, or tax liability against which to charge the investment tax credit (ITC), these benefits will be lost.

A lease can shift the depreciation and investment tax credit to another party, which in turn can make effective use of it and pass its benefits through in the form of reduced monthly payments.

• For financial reporting. Leasing used to be called off-balance-sheet financing because leases did not have to be disclosed in a company's financial reports. Today, lease obligations must be disclosed on the balance sheet in some fashion, although such disclosure is only a summary form for many leases. As a result, for all practical purposes, a good deal of leasing is still off-balance-sheet financing.

Types of Leases

Computer leasing has its real beginnings in a company's initial decision to acquire a computer. At that time, the specific type and model of computer are selected and the foundation for late economic evaluation of lease proposals is also established.

A user company has choices when acquiring and financing a computer without buying it. The company can rent from the manufacturer on a month-to-month basis, which, unless the equipment is needed for only a short time, is the most expensive way to finance a computer. Or the company can lease from the manufacturer, which is somewhat less costly because a time commitment is traded off against the monthly rent.

The third option a user company has is to lease from a third party. In a third-party lease, a separate leasing company (the lessor) owns the equipment and leases it to the user (the lessee). The main reason for leasing from a third party is to save money.

Third-party computer leases are marketed in several forms, which differ in fairly subtle ways. In the leasing business, five categories of leases are common:

• Operating lease: both a marketing name and a financial accounting classification. In marketing, it usually means a lease in which:

☐ The initial lease term is less than five years.

☐ Monthly payments accumulate during the initial lease term to an amount that is quite a bit less than the purchase price of the computer.

• Full payout lease, sometimes referred to as a financial lease or net lease or a variety of other names. Most computer leases are full payout leases. Their most distinguishing features are:

☐ The initial lease term is generally at least five years; terms of from seven to eight years have been common. Although longer terms may be written for other kinds of equipment, they are rare for computers.

☐ Monthly payments accumulate to the original purchase price of the computer partway through the initial term.

Risk comparison: *There is a major difference between short-term operating and long-term full payment leases at the level of the risk assumed by the lessor. A short-term operating lease is likely not to pay off all of a loan made to finance the lease, so the lessor takes the very real risk of losing all of its investment and more if the market value of the computer falls too far by the time of re-leasing. With a full payout lease, that risk is considerably decreased, because at least the loan is paid off.*

• Leveraged lease. The most competitively priced computer leases are leveraged as well as full payout, to take advantage of certain provisions in the tax laws:

☐ Deductibility of interest paid on debt. Deducting interest produces a tax saving benefit that leads to leveraging. The lessor's side of a lease is structured with 10% to 40% equity

Detach here, moisten and seal envelope securely before mailing.

Fold and insert order form (attached through binding) and remittance here.

ownership and 60% to 90% debt. The leveraging comes from applying 100% of the tax benefits to the equity owner's 10% to 40% share of the investment.

☐ Accelerated depreciation. Accelerated depreciation rules make leveraging more attractive by front-loading some of the tax benefits. Since there is a time value to money, this becomes another big advantage.

☐ Investment tax credit: In a sense, leveraged leasing reaches its highest form when the investment tax credit is included in the deal, because then the maximum quantity of tax benefits is leveraged. This allows for very low lease rates — in fact, the lowest available. Rents can easily be 20% lower with a leveraged lease than without leveraging.

• Capital lease: As an alternative to using a conditional sales contract, a lease that looks a lot like a full payout lease can be used to finance acquisition of an asset that will become property of the lessee at the end of the lease. A capital lease and a conditional sales contract are considered to be practical equivalents of each other. They are not true leases and do not produce the ownership benefits that enable the lessor to offer very low cost for the lessee.

• True lease: In the explicit use of this name, this is a tax classification. As a practical matter, it is also just another name for an operating lease or a long-term lease that is classified as an operating lease for tax and financial accounting purposes. Even more, it is a name that is commonly used in marketing such leases.

The great majority of computer leases are true leases, in which the lessor takes the risks and obtains the benefits of ownership.

Variations With Time: *Unfortunately, names tend to change over time as tax and accounting rules change, as marketing customs and tactics change and as creative underwriters devise new and more convoluted lease forms. Consequently, there is no absolute, explicit or unambiguous set of definitions for all time. However, it is easy to bear in mind that there is a practical difference between a true lease and something else that is not a true lease, regardless of its name or surface appearance.*

PROPOSAL COMPETITION

It is advisable to award business to outside suppliers or vendors through competitive bidding. Although there may be exceptional circumstances in which a noncompetitive award may be the correct choice, under normal conditions competition is desirable.

The beginner has a lot to learn. Lessors are unknown, so there is no reliable way to tell who is good and who is not. The variety of contracts offered by different lessors makes it difficult to decide what is appropriate for your company. It is equally difficult to tell what constitutes a fair price in the current financial environment. At a more advanced stage of leasing experience, a company may find itself with several current lessors. Opinions about contractual arrangements may have been translated into company policies for and against certain choices. The company may even have chosen a lessor. What if that lessor should slide up in price? The fair-price question never goes away.

Conducting a good bidding competition will help you make a good choice. Besides, it can be a lot of fun.

Request for Proposals

The Request for proposals (RFP) is a formal document that defines for your company and for the competing bidders conditions that must be met if a proposal is to be considered. Each point should be covered concisely and explicitly. The RFP will answer most questions bidders would otherwise have to telephone to ask.

An RFP should consist of three or four parts:

• A cover letter inviting the addressees to bid.

• Proposal specifications. Specifications are the critical part of the RFP because they establish a set of rules that can be used to accept or reject proposals. They also state certain basic requirements or limitations to what your company will accept. A good set of specifications might include:

☐ Requirements (lease terms under consideration, renewal and purchase options desired).

☐ Bidder requirements (full disclosure of principals to be required).

☐ Financial requirements (financial statements, invoice and payment time allowances).

☐ Negotiation requirements (one negotiator for the lessor).

☐ Equipment information (equipment list and installation schedule, lessor commitment to finance upgrades, planned maintenance arrangement).

☐ Submission of proposals (sealed bids with cover letter requested, submission deadline and proposal opening date).

☐ Lessee's right to withdraw or reject all bids.

• A price proposal form. A price proposal form helps ensure there will be no misunderstanding about the proposed monthly rents. It should summarize the equipment to be leased and its new purchase price if it is being acquired from the manufacturer. Most important, the form should call for the bidder to state the rent in dollars per month and to specify what ITC treatment goes with each rental figure.

• A manufacturer's price quotation for purchase of the computer may also be appropriate.

Bidder's List

A bidder's list is nothing more nor less than a list of potential lessors and agents to whom RFP packages will be sent. As a bare minimum, it should contain no fewer than three names; six is a more practical minimum because some addressees may not respond. Your aim is to obtain at least three competitive, responsible proposals.

If you are new to leasing, be careful not to send out too many RFPs; it is too easy to become saturated and confused if you get too many proposals. After you've had some experience, 10 proposals is a reasonable number to evaluate, and 12 to 15 names becomes a good number.

The bidder selection process begins with opening bids and examining each proposal for responsiveness to the RFP and specifications. Each proposal should be required to meet some minimum standard of compliance with all terms of your specifications before you evaluate it for economical impact.

Economic impact is commonly measured in terms of cash flow and/or present value cost to the company (the cash flow discounted to the present at the company's cost of money). Economic impact can also be measured by net income or by contribution to retained earnings, but these are really financial rather than economic measures.

Lease Rate Expectations

At any given time, in any given marketplace, there is a fair price for a computer lease. You want to get the best lease rate that is at the low end of the prevailing fair price range. This is a good reason for holding a competition, which will tell you what a fair price is. How low a price you can get depends not only on competitive influences, but also on the kind of contract you go after. The following list rates types of contracts:

• Short-term rent from the manufacturer (most expensive).

• Lease from the manufacturer (next most expensive, about 15% to 20% less than renting).

• Short-term third-party operating lease (25% to 30% below renting from the manufacturer and 10% to 15% below the manufacturer's lease).

• Third-party leveraged full payout leases (lowest cost, approximately 40% to 60% below manufacturer rent and 30% to 40% below manufacturer lease).

• Nonleveraged full payout leases (can easily cost as much as 20% to 25% more than leveraged leases).

WINNING BIDDER

Pick a bidder with whom you feel quite comfortable doing business. You must live with the deal, so make sure you are comfortable with the selection, both personally and as a representative of your company. Other general qualifications of a suitable, successful bidder are that the leasing company have the financial resources necessary to complete the contract and that they be technically competent, financially responsible and reasonable to deal with.

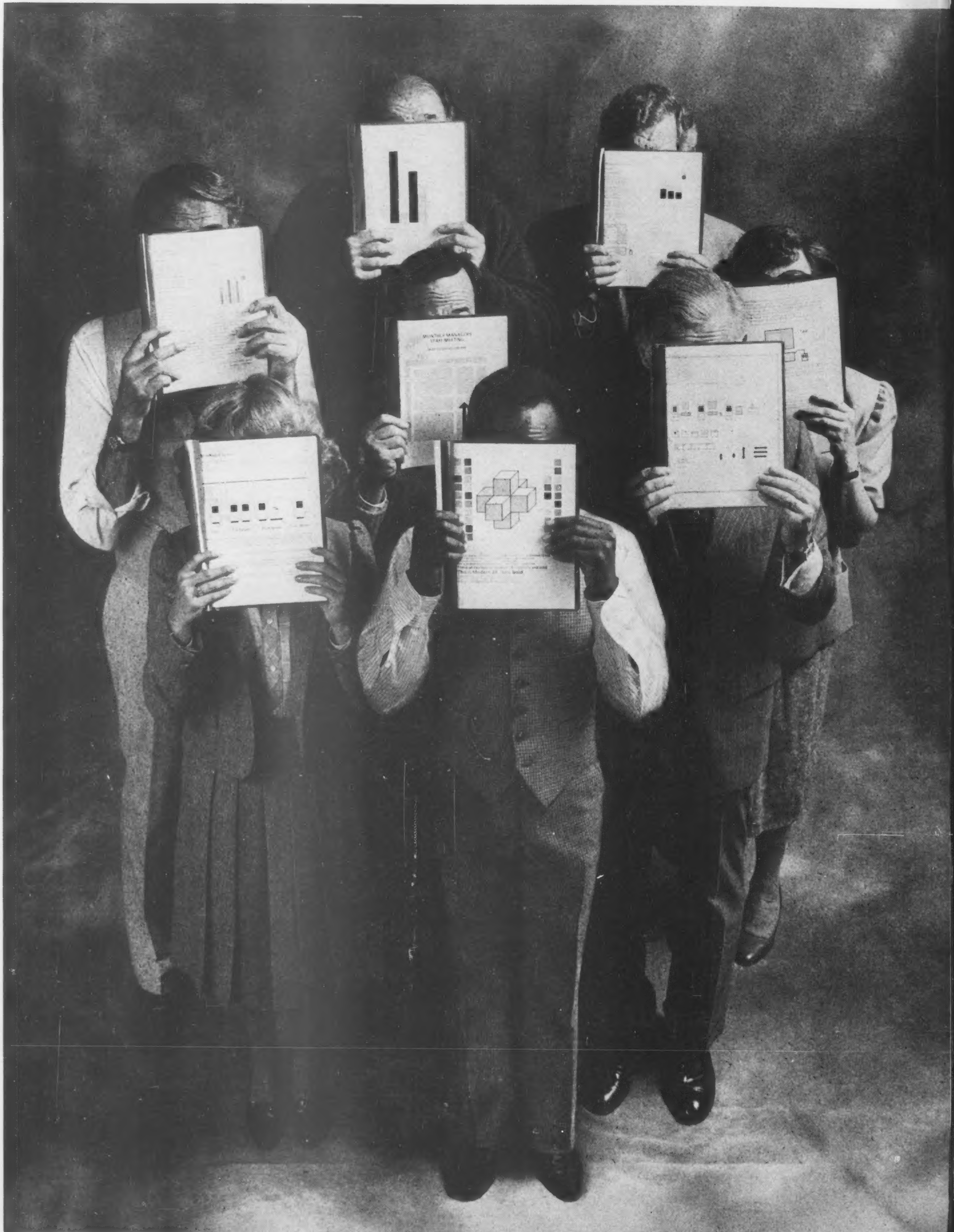
Your initial selection should be only tentative. Although the specifications should have informed all bidders that they must be willing to negotiate, no way exists to test the degree of that willingness short of entering negotiation itself. Therefore, when you first notify your selected winner, be sure to stress the need to reach agreement on contract terms before the contract will actually be closed.

ECONOMIC RECOVERY ACT

On Aug. 13, 1981, so-called "Safe Harbor" rules for classifying leases as true leases for tax purposes were signed into law as the Economic Recovery Act of 1981 (Erta).

One of the stated purposes of Erta was to decrease business tax liabilities. This was accomplished by in-

Pick a bidder with whom you feel quite comfortable doing business.



creasing the tax benefits attributable to accelerated depreciation and ITC for all assets acquired after 1980. Under the accelerated cost recovery system (ACRS), useful life for tax purposes was reduced to five years for most equipment, including computers.

Two real changes were made to the ITC rules: The maximum 10% ITC is available for five-year and longer useful tax life (formerly seven years) and ITC is now vested at the rate of 2% per year (formerly 3.33% each at three, five and seven years).

A second stated purpose of Erta was to increase the usefulness of tax benefits by allowing them to be sold. A new category of true lease was created to treat the lessor as the owner of an asset for claiming all or some of the tax benefits of ownership, but without necessarily becoming the legal owner in fact.

Safe Harbor permits true lease treatment of transactions that are designed for selling only tax benefits but not the assets, using lease formats to fit into the new rules. In effect, the rules for these transactions are very nonrestrictive, and they are classified as true leases because the lessor and lessee say they are true leases.

This is quite a contrast with previous tax law, under which classification depended on conformity with fairly restrictive rules. A more drastic change is hard to imagine.

The requirement that lessor and lessee affirmatively declare their intentions to treat a transaction as a lease seems to be the cornerstone rule permitting Safe Harbor true lease classification. Other rule changes are also loosening the bonds, though not so much.

Under the Erta rules, a lease can be structured for the lessor to:

- Pay the lessee a fraction of the purchase price of the computer.
- Borrow the rest of the purchase price from the lessee.
- Claim the ITC and other tax benefits of ownership.
- Lease the equipment to the lessee for a rent that exactly equals the loan amortization payment, so that no money changes hands month by month.
- Sell the equipment back to the lessee for $1 at the end of the lease.

Incompatibility With Fasb No. 13

By allowing bargain purchase options and lessee contributions to financing, the Erta Safe Harbor rules are clearly incompatible with Fasb No. 13 rules for operating lease classification. However, Erta also allows the lessor and lessee to avail themselves of the previous rules for classifying leases for tax purposes if they prefer.

Erta is a significant change from past tax rules and is so different from financial accounting rules that it is hard to know what its impact will be. The best present bet is that there will be two groups of lessees existing side by side, depending on the individual circumstances of each transaction: One, leases that conform to pre-1981 tax law and Fasb No. 13 rules for classifying leases as operating leases for financial accounting and reporting purposes, and, two, leases that take advantage of the Erta Safe Harbor in situations that make the cash-flow advantages of tax benefits far outweigh any financial accounting and reporting advantages of operating lease status under Fasb No. 13 rules. Except for differences in the numbers and parties involved, the two groups can be expected to resemble each other far more than they differ.

Erta will have no effect on the most important facts about computer leasing: A lease will still be a lease, and lessees will still have to become knowledgeable in order to protect their interests properly. ◆ ‡

Beers is a staff manager at New York Telephone Co. This article has been adapted from his book, Computer Leasing, *© Copyright 1982, to be published this month by Lifetime Learning Publications, Belmont, Calif.*

E X T R A

NEW WAVE
IN BUSINESS GRAPHICS

Business graphics today is in a position similar to that of word processing in the late 1960s — with one key difference. Word processors evolved from similar appearing devices, whereas the new business graphics systems necessitate merging computer graphics technology with established graphic arts techniques. Graphics illustration must move from brushes, pencils and mechanicals to a keyboard, stylus and video display — a transition much more difficult than the move from a typewriter to a word processor.

Two distinct functions — financial reporting and graphic arts — merged to form business graphics. Traditionally, data for financial reporting was gathered manually, but data processing has matured to the point where computer reporting is routinely available to small and large businesses. In fact, financial reporting is no longer limited merely to stating past results; financial managers now use

By Robert Varga

COURTESY OF APPLICON INC.

modeling systems to analyze past performance and to produce forecasts that can be merged with budgeted and existing information.

The growing complexity of business led to the development of today's query systems and report generators, which tap into extensive data bases, thus creating a new set of problems. Decision makers were deluged with volumes of printouts representing endless recaps, forecasts and analyses — in short, paper proliferation. Something had to be done to make the information more digestible.

Computer graphics representations were an obvious answer. In the past — and even now — most business charts were prepared manually; illustrations were drawn and pasted up into mechanicals in the form of graphs and charts representing financial and strategic information. Even today, large corporations have chart rooms where hundreds of charts are prepared manually and tacked on the walls for review.

From such charts and graphs, a noticeable trend emerged: Graphics designers tended to follow proven formulas. Preferred chart standards were defined and published, and the only difference from one report period to the next was the actual data. For financial managers producing recurring reports, there was a need to standardize the format. The next logical step, then, was to develop the capability to create these charts by means of computers. Libraries of chart formats could then be generated and saved for later use. Individual formats could be recalled to create updated charts and graphs from information in the data base.

In this oversimplified context, business computer graphics was born and has emerged as a cost-effective solution to generating reports and presentations. (Cost-justification for a $50,000 slide-generating system begins at approximately 100 slides per month. In volume, actual slide costs may be as low as $10.) The remainder of the decade will show if the market grows in the same manner as word processing did in the 1970s.

Emerging Marketplace

Purchasers of business graphics systems — corporations, financial institutions, service bureaus and individuals — have something in common: the conviction to use charts in reports and presentations and the commitment to automate procedures for chart creation and production.

Many users also have a technical commonality. They are knowledgeable about their requirements and the technology needed to meet them. They often have a conversant knowledge of computer graphics. Some have built their own business graphics systems by integrating hardware and software from independent suppliers. Others have acquired hardware and developed software on their own. In these instances, end-user acquisitions may be technically intensive and time-consuming; if this remains so, it will limit the rate at which the market can grow.

In another expanding part of the market, users are purchasing turnkey systems and relying entirely on one source for all parts of the graphics system. Many believe a volume market will emerge when such turnkey vendors can successfully target their products to have broad appeal to the nontechnical end user. In this domain, issues of which microprocessor or what operating system to select will fade. Instead, users that need a chart-making system will want to know more about how the system will integrate with staff skills and office work flow and how it will meet productivity and quality standards.

An analogy to word processing is helpful at this point. Typical purchasers and operators know little about internal machine architecture, but they do want to know about the number of text lines that will fit on a screen, edit capabilities, print options, training programs and vendor policies on emergency calls. Most vendors still have a long way

to go if they hope to experience a volume market in business graphics similar to that of word processing.

Part of the problem is the complexity in the market and the extensive resources required to support any single segment of it adequately. In fact, the term business graphics can mean different things, encompassing two main functions: chart composition and edit, and financial data base review. These are commonly referred to as presentation systems and decision support systems (DSS).

Software vendors and systems integrators typically have emphasized one of these functions to the exclusion of the other. The reason is related to another dimension in the user equation — each user has his own style standard for graphics form and content. Every corporation has unique reporting requirements that may or may not follow good graphic arts precepts. This may be the case at divisional, departmental and individual levels within a company.

Also, graphic arts service bureaus serve both large and small companies and must satisfy the broad requirements of their entire customer base. The net effect is that a presentation system or a DSS must be either custom-designed or sufficiently flexible and comprehensive to accommodate the wide range of user needs.

How then does one decide which computer graphics system is the right one? Carefully! There are user needs, and there are vendor solutions. In the best of situations, the two are on common footing.

System functionality is a major consideration when purchasing a computer graphics system. Aside from that, vendor battle lines in the current marketplace are drawn between business graphics systems that are centralized (shared by a number of users) and those that are dedicated to individual users. To the suppliers, the issues are system architecture and sales; to the users, unit cost per workstation, capability and productivity.

All computer graphics systems have the same elements: display monitor, keyboard (or other input device), central processor, graphics processor, graphics software and output devices. In a centralized system, expensive resources — the CPU, graphics application software, mass storage and output devices — can be shared by a number of users who communicate to the central CPU (and these resources) via a low-cost graphics terminal.

Although capital outlay for this concept is high, it can be justified by amortizing costs over a large user base. Most often, the processor (a mainframe or minicomputer) is already in place, making the incremental decision for graphics easier. As the number of users increases, however, competition for these resources reduces human productivity.

By contrast, a dedicated (sometimes called stand-alone) graphics system puts all the resources locally at one user's disposal. All things being equal, this architecture would appear to offer more in the way of user productivity. This is not the case — yet.

Mainframe computers have been around longer; business graphics software had its origins and reached maturity on mainframes. The best-known business applications package for mainframes has survived well over five years of change in vendor hardware and has been installed in more than 1,000 sites. There is nothing comparable in dedicated business graphics systems.

The reason for such longevity, according to some suppliers, is a software design philosophy that makes the software product relatively immune to hardware changes (these are referred to as device-independent packages). This is not so. The real reason for this longevity is that mainframe computer vendors have committed their support to commonly used software languages, such as Fortran, and have reasonably maintained compatibility among operating systems that have evolved with their product lines. Moreover, mainframe computers deliver the computing punch required for comprehensive business graphics systems. The net effect is stability — seen by users as a significant advantage.

Designers of dedicated graphics systems would do well to follow this lead. In contrast, 8-bit microprocessor-based graphics systems appeared about five years ago. By the time reasonably capable business applications packages began to be accepted, 16-bit systems had appeared, complete with new operating systems and new language options. This market segment is viewed by many as "life in the fast lane."

Potential buyers often hedge against such change by opting for the centralized system concept or by waiting to see what technology will bring next year. The graphics technology advances announced in recent months strongly suggest that the polarized options for dedicated and shared resources will dissolve in this decade. Terminal products are becoming more intelligent and will have the processing power that minicomputers have today. Dedicated graphics workstations will be configured as stand-alones or in networks to give the best of both worlds: local graphics processing power and shared resources within the network.

User Profiles

Business graphics systems today are hard pressed to meet the comprehensive functional requirements of the marketplace. Meeting the operational needs of the user is an entirely different domain, and this is where the term "user-friendly" enters — a phrase often heard in connection with the scores of hardware, software and turnkey systems in the current market. They can't all be friendly; someone is exaggerating. In most cases, it is probably more accurate to use the term "user-tolerant."

User-friendly means different things to different people. To some, it means conversing with the computer:

Computer: *Hello. My name is Fred, what's yours?*

Designer: *Hello. My name is Bob.*

Computer: *Hi Bob, what do you want?*

Designer: *I want to make a pie chart.*

To others it means cryptic commands using a home-grown graphics language:

☐ P4; R100; X300, Y200; 10, 20, 30, 40; R, GB, -Y (which means a pie chart with four segments; radius 100 units, located at X=300, Y=200 pixels; values: 10, 20, 30, 40; colors red, green, blue, yellow, explode the yellow segment).

In reality, user-friendliness addresses the operating procedures of the user. It concerns the work to be done and the skills of the person doing it. It is an amalgamation of knowledge that merges procedures, job culture and human factors. For example, in a business graphics composition/edit system, the interaction should be point and see, not read and type. It should have cut-and-paste features and should use colors for visual cues, messages for status, errors and help. It is predictable, follows consistent logical rules with similar-appearing operations and is functionally comprehensive. It does not outthink the designer by imposing artificial, albeit logically appealing, rules. It is interactive and responsive and encourages the natural trial-and-error process typical of graphics design.

In designing or purchasing a business graphics system, two types of users with two different needs must be considered: the person preparing the graphics and the person presenting them. Whether the system is for graphics design and edit or for decision support, both users play a role.

The preparer is involved in the creation of original graphics. (In presentation graphics, this is the entire job.) The preparer is the focal point of the user-friendly design. Because

In a business graphics composition/edit system, the interaction should be point and see, not read and type.

the driving forces in many companies may originate from a number of sources, such as corporate DP, finance or graphics services departments, today's preparer comes from many diverse job backgrounds. This explains why there are so many different opinions about the proper user interface. It also points out the challenge of implementing an effective user interface.

At present, the influence of a graphics artist or illustrator is essential for layout and design, color selection, choice of fonts, font size and so on. An illustrator is trained to put together these factors to get purposeful and appealing charts — something the typical manager or clerical person may have difficulty doing.

Moreover, use of an illustrator is an efficient application of skills. With some dedicated systems, a "camera-ready" chart can be designed in about three minutes. Most of the time, however, the color combinations, fonts and general layout need to be fine tuned. An inexperienced person can spend an hour or more making adjustments that lead to better — but often still questionable — design.

To illustrate the point on color selection alone, consider a man whose wardrobe consists of slacks in 64 shades, shirts in 64 shades, ties in 64 shades, 64 pairs of shoes and so on. If he had to decide exactly what combinations to wear each morning, he would never get to work. How does he cross the hurdle? He uses the expertise of a clothing salesperson to help select combinations

In future, the role of the illustrator will be to develop preformatted charts that clerical and managerial people, unfamiliar with design techniques, can use to generate graphics. Today, a number of systems exist that accommodate this operation.

The second type of user, the presenter, works with the output of the graphics system: film, paper or video image. If the preparer drives the interface design in a presentation graphics system, the presenter determines the functionality and comprehensiveness of the system. For example, a financial manager typically is interested in line or bar charts; for trends and projections, some statistical capability is desired. A marketing manager who wants to know market-share information might emphasize the use of pie charts. Project management needs milestone charts and flow diagrams.

In a DSS, the presenter determines the interface design as well. These systems emphasize data access and display. They are used by managers, so the skills and training required to utilize the system are quite different from those needed for a composition station. The hardware may also be quite different. Touch-screen selection may be used instead of keyboards and so on.

Each of the two user types may possess entirely different skills and responsibilities. If a business graphics system is designed only to meet functional requirements, but ignores the user, it has solved only half a problem — the easier half.

Business graphics systems are used at three levels — design, production and review; each requires different types of hardware. At the design level, graphics are composed, edited, stored and retrieved. Data may be accessed and reviewed with previously designed charts for prescreening. Hardware requirements include a display screen, an input device (keyboard, cursor, monitoring device and so on) and mass storage.

At the production level, charts are merged with data and captured as hard copy on film, transparencies, paper or videotape. The production station may be the same as the composition station, but would include other hardware such as film recorders, printers, video encoders and tape recorders (see article above).

Review-level operations include decision support and boardroom-type presentations. The hardware may include much of that used for chart composition and may also feature touch-screen displays or voice input for chart selection.

Raster-scan technology is emerging as the leading display technology in computer graphics; for business graphics applications, it is the leader. Raster-based devices offer full color, low-to-high resolution and design flexibility. In a raster system, images are stored digitally in semiconductor memory, which is scanned every one-thirtieth or one-sixtieth of a second to refresh the screen image. As semiconductor memory costs have dropped, raster-based displays have become a very affordable display solution.

Screen resolution is a term that refers to the number of individual points on the screen that make up an image. These are referred to as pixels, or picture elements. Screen resolution has a direct bearing on picture quality and the amount of information that can be displayed. Medium-resolution systems (640 by 480 pixels) should be the starting point for all but the simplest business graphics needs. They are quite adequate for chart design and review. There are trends toward higher resolution systems (1,024 by 768 and 1,280 by 1,024), but the available screen size, 19 inches, can be overwhelming for operations such as chart design. (Imagine viewing a TV with your face 18 to 24 inches from a 19-in. diagonal tube.) However, higher resolution systems are nice for simultaneous chart display and operating menus.

There are also trends at the resolution spectrum's low end. Here, mainframe software systems with preformatted charts enable low-resolution terminals and personal computers to generate primitive graphics, which are then transmitted to the mainframe, redrawn at higher resolution and captured on a video film recorder.

The most useful display system for business graphics applications may be pixel-addressable graphics, as opposed to character graphics. In a pixel-addressable system, the color of each position on the screen can be controlled. Characters, lines and solid areas can be drawn and positioned anywhere on the screen and colored. In contrast, character graphics systems permit color control over a block of pixels. This effectively reduces screen resolution and detracts from the information content and picture quality.

The keyboard is the most common device for entering data into the graphics system. For the graphics designer, a combination of the keyboard and a mouse, stylus or puck (the latter two used with a graphics tablet) offers an efficient means to interact with the display screen image. The keyboard is used for text and fine positioning of chart features, and the mouse, stylus or puck is used for coarse positioning — selecting menus or pointing to chart features. Touch pads are also used in this fashion, but require light finger movements over a small (4-in. by 4-in.) surface.

Two relatively new input devices

New Wave Color Hard Copy

All computer graphics systems offer a "soft" image stored in memory. This image can be previewed, modified or manipulated on the color monitor.

But to get that image converted to a paper for a report or to a slide for projection in a conference room screen is another matter.

Plain paper, which is reproducible, may suffice for a written report distributed in quantity. However, there is a great deal of color loss. If you need hard copy with full color saturation, only a photographic system will suffice.

As graphics terminals attain more color capability — up to perhaps 4,096 individual colors — only photographic systems can recreate and differentiate subtle changes in hue, intensity and saturation. And to produce 35mm slides directly, the photographic method is the only technology available.

One of the early photographic systems, introduced three to four years ago, cost $15,000 to $20,000. (Actually, these systems created a color-enhanced black-and-white image.) Shortly thereafter, prices dropped 25%. Most recently, Polaroid introduced a system to make 8- by 10-in. prints or transparencies for $6,000. However, there is still room for greater price reductions and performance enhancements as well.

One of the latest systems is a computer camera from Celtic Technology, Inc., the VFR-2000. It was designed to operate with most computer graphics systems and is connected by three or four standard BNC connector cables. Film advance and rewind is completely automatic; there are no adjustments or controls the operator has to fiddle with. The 35mm film cassette is loaded into the front-end and, once exposed, developed like any other film. Best of all, the price is $2,495.

How personal can a computer be?

Hewlett-Packard has three completely new answers.

Introducing desk
for managers. A new tool po
And a way to take your

For a computer to be really personal, it's got to work the way you work. And solve your kinds of problems.

Obviously, no one computer can do it all.

So we created six different series of personal computers—ranging from pocket-sized to super-powered—with an equally diverse list of features.

Today, we're introducing three new computers to the line.

So now, you can choose a computer that's not only "personal" by our definition... but by yours.

Fast answers for decision-makers.

Now, managers can get the information they need, whenever they want it. Just the way they'd like it: words, numbers or graphics. From a computer that sits on a desk... without taking it over.

It's Hewlett Packard's new Series 100, Model 120.

Take a good look at the Model 120. It has a special tilt-swivel base that lets you adjust the computer to your eye level. And a super-clear, easy-to-read display. It has special function keys to help guide you through the program. And something else you shouldn't overlook: HP-IB. The interface bus that allows you to hook-up printers and plotters to the computer as easily as you plug the computer into your wall.

Now, take a look inside the Model 120. You'll find the software every decision-maker needs. A powerful database management system... WordStar® word processing... and VisiCalc,® the electronic spreadsheet. But unlike some other personal computers, it takes just one keystroke to give commands—instead of two or three. That saves you a lot of time... and frustration.

The best of both worlds for scientists and engineers.

As a scientist, designer or engineer, you've always had two choices. Big power... or personal size. Not both.

Now, you can have a computer that's powerful enough to handle design, computation and testing. And small enough to fit on your lab bench or desk—along with everything else you've got on it.

It's HP's new Series 200, Model 16.

The Model 16 has the power, memory and graphics capabilities you've asked for. (8 MHz, MC68000 micro-processor. 16/32 bit architecture. Memory expandable up to 768K

Decision-support

top decision support
werful enough for engineers.
office anywhere you go.

bytes. 300 x 400 pixel screen resolution.)

And it also has some extra features you probably wouldn't expect. There are three languages to choose from—enhanced BASIC, compiled Pascal and HPL. And a comprehensive library of software packages to go with them. We built HP-IB and RS232 interfaces into the machine. (So you can attach peripherals or instruments without adding I/O cards.) And we even included a special rotary control knob that lets you adjust instruments or control motor speeds the same way you'd tune in a radio station.

Portable power for the professional on the move.

If you spend as much time out of your office as in it, you'd probably like a way to take your office with you. And now you can—with HP's Series 70, Model 75. It's a powerful, battery-driven computer that fits in your briefcase.

With its typewriter-like keyboard, 16K RAM (expandable to 24K) and 48K ROM, the HP-75 acts like a full-size desktop computer. But it's just a little larger than an airline ticket folder. And it weighs only 26 ounces.

What can such a small machine do? Investment or financial analysis. Real estate. Statistics. It can manage files. Write memos. Keep track of your appointments ...and let you know when it's time to go. In short, the HP-75 can do just about anything a full-size computer can do. Except it can do it while you're sitting on a plane.

Back down on the ground, you can use the HP-75's HP-IL interface to hook-up a video monitor, TV screen, printer or plotter.

You'll be glad to know that the HP-75's price tag is easy-to-take, too. The basic package comes in at under $1,000*

The right tool for the job.

The rest of the Hewlett-Packard family of individual computers includes pocket-sized professional calculators, powerful hand-held computers, portable computers and personal office computers. Each has its own special features and focus.

For a closer look at HP's personal computers, and a copy of our 20-page book, *Choosing The Right Tool for the Job*, visit your local Hewlett-Packard sales office or authorized HP computer dealer. Call 800-547-3400 (in Alaska, Hawaii or Oregon 503-758-1010) for the location nearest you.

*U.S. list price.

HEWLETT PACKARD

The no-compromise choice for engineers and scientists. The Model 16.

Desktop power that fits in a briefcase. The HP 75.

WordStar® is a registered trademark of MicroPro Int.
VisiCalc® is a registered trademark of VisiCorp.

TC02210

are touch screens and voice-input systems. Touch screens, where the user actually touches the screen to interact with the display, are not practical for design stations because constant reaching for the CRT screen can become tiring. They are better suited as review stations, where the user can call up data simply by touching options on the display. Here the user spends most of the time viewing the chart and less time selecting options.

In voice-input systems, the user gives verbal instructions to the computer, which acts on them as though they were keyboard-activated instructions. Although useful for presentations, these systems are not well suited for graphics design. Most voice-input devices still rely on single-word utterances and therefore require a graphics language command-driven system. Further, an operator using such a system probably would become hoarse by the time a few charts were designed.

Hard-copy output is available in a variety of forms (photographs, 35mm slides, overhead transparencies, 16mm film, printed paper and videotape), each with its own place in the business graphics system.

Film recorders appear to be the leading technology for producing quality-color hard copy. Some film recorders take the video signal direct from the system to produce a slide or transparency at the same resolution as the design screen. Others can take a digital representation of an image and redraw it at a higher resolution (for example, 4,000 by 4,000 points), producing studio-quality hard copy.

Color transparencies represent an essential media for business presentations. Copy is available currently from "instant" 8 by 10 film exposed in commonly available video film recorders. Each copy costs about $10. Production is awkward and not goof-proof, and it requires non-standard-size transparency frames. Other options include the color laser printer.

Paper color hard copy is available from impact, ink-jet, pen-plotter and laser printers. Impact and ink-jet printers do not produce colors true to the screen image, and they are slow — an 8 by 10 chart can take two to three minutes to print. Some, including the laser printers, are limited to eight colors, but other colors may be simulated with patterns that produce shading effects. The pen plotter is really a line-drawing device and is not well matched for producing solid colors from a raster display. Solid-color images are printable by laying down many lines, but the process is very slow.

What is missing from these options is a low-cost ($5,000), fast, quality-color print system. Generating multiple copies for reports or presentation handouts can be a ludicrous proposition with most color printers. For example, consider producing 50 copies of a report containing 20 color charts. The reproduction time for most color printers would be 50 hours of continuous running. If you had a $30,000 laser printer, this time could be reduced by a factor of about five.

While the world of raster-scan graphics is color, most reproduction equipment in the office is black and white. To get copies of charts in quantity, we must address the subject of black-and-white output. Although all printer systems support black-and-white hard copy, most systems integrators ignore the need to offer a black-and-white image option in their color graphics systems. Making black-and-white photocopies from color originals can be a risky proposition because the various photocopy devices respond differently to color — some respond strongly to reds and yellows and most suppress blue to some degree. But from a black-and-white original, common office copiers can reproduce multiple copies cheaply.

Videotape is often overlooked as a form of output. Useful in sales, marketing and advertising, videotape captures financial highlights for dissemination to decision makers well in advance of the publication of a printed report.

What does the future hold? Business computer graphics is here to stay. However, serving this growing market means more than just providing hardware. The need is for total systems solutions that will meet the needs of both skilled and unskilled users and will help the artist, manager and computer operator make the transition to new technology as painless as possible. ◆

Varga is director of business graphics at Ramtek Corp. in Santa Clara, Calif. ‡

ADVERTISERS' INDEX

This index is provided as an additional service. The publisher does not assume any liability for errors or omissions.